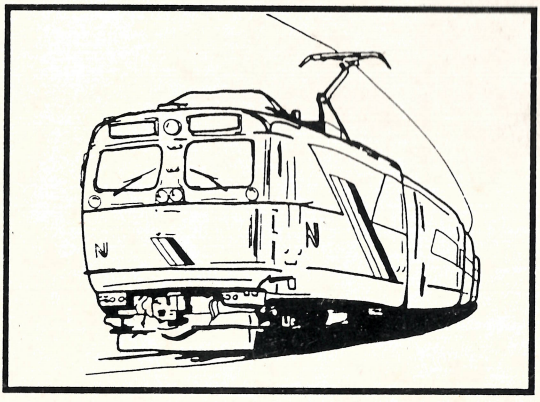
NJ TRANSIT

ALP-44 LOCOMOTIVE



OPERATING INSTRUCTIONS

November 1990

ABB

ABB TRACTION, INC.
Trenton, New Jersey

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SECTION 1.
GENERAL DESCRIPTION

The NJT ALP-44 vehicle can operate as a single unit or in a multiple unit consist of two or three locomotives. It can also be operated from a cab car.

Power comes in from an overhead alternating current supply through a pantograph to the main circuit breaker. The overhead line voltage is 11 kV at 25 Hz, 12.5 kV at 60 Hz, or 25 kV at 60 Hz. Output from the circuit breaker is applied to two primary windings of the main transformer. The two primary windings are connected in parallel when the overhead line voltage is 11 kV at 25 Hz or 12.5 kV at 60 Hz. The two primary windings are connected in series when overhead line voltage is 25 kV at 60 Hz. A motor driven tap changer switch which makes the parallel or series connection is located in the main transformer tank.

The main transformer is a fixed ratio type multiple secondary transformer. Output of the multiple secondaries is rectified and regulated by thyristor controlled converter bridges and smoothed by reactors to provide direct current to the traction motor armatures. The smoothing reactors are located in the main transformer tank. Additional secondary windings of the main transformer provide power for the traction motor field converters, HEP converters, auxiliary power converters, and the battery charger via an auxiliary transformer.

The transformer and smoothing reactors, located in the main transformer tank, are cooled by circulating silicone oil between the transformer windings and between the reactor windings.

The thyristor controlled converters for armature current, field current, HEP, and auxiliary power are in the Y1 thyristor converter cabinet. The thyristors and rectifying diodes of the converter units are mounted on heat sinks in unitized racks in the same cabinet. The thyristors and diodes are cooled by circulating oil through the heat sinks.

The cooling oil system for the transformer and reactor is separated from the thyristor converter cooling oil system. The oil from both systems is forced through heat exchangers centrally located in the Y1 thyristor converter. Air taken in through vents in the roof hatch is forced down through the heat exchangers, then discharged beneath the locomotive.

The four traction motors are forced air ventilated, separately excited, direct current motors. Traction motor blowers provide cooling air for each traction motor. The cooling air is taken in at the roof hatch and forced through inertial filters for cleaning, then through the traction motors. A portion of the cooling air from the inertial filters is also forced through paper element filters into the equipment cabinets.

Power for lighting, heating, and cooling the passenger cars is provided by a HEP converter. Power is taken from two auxiliary windings of the main transformer and applied to the HEP converter in the Y1 thyristor converter cabinet located in the equipment room. The HEP converter (Y3) rectifies the single phase output from the two secondary windings. The rectified power is then converted into three phase, 480 V 60 Hz. This power is applied to the cars heating, cooling, and lighting.

Power for cab air conditioning and cab heater blowers is provided by a transformer that steps down one phase of 480 VAC 3 phase power from the head end power convertor to single phase 110 VAC.

Power for operating auxiliary equipment is provided by an auxiliary power (APL) converter (S7). Auxiliary equipment includes the transformer cooling oil pump motor, thyristor converter cooling oil pump motor, traction motor blower motors, equipment room blower motor, converter radiator blower motors, rotary air compressor drive motor, air compressor radiator blower motor, and thyristor converter internal blower.

Power is taken from two auxiliary windings of the main transformer and applied to the APL converter in the Y1 thyristor converter cabinet located in the equipment room. The auxiliary power converter rectifies this single phase power, then converts the rectified power into three phase, 440 V, 60 Hz. This power is applied to the auxiliary equipment as required.

Power for the battery charger, cab heaters and windshield heaters is taken from an auxiliary transformer. This transformer normally takes power from the APL converter, but can also take power from the HEP trainline.

GENERAL ARRANGEMENT

Figures 1-1 through 1-6 show the locations of key components in the ALP-44 Electric Locomotive.

1. Drop-Sash Windows
2. Cab Door
3. Equipment Removal/Pantograph Hatch
4. Y3 HEP Control/Filter/Contactor Cabinet
5. Pantograph
6. Thyristor Cooling Component and Main Transformer Removal Hatch
7. Y1 Thyristor Converter Cabinet, Propulsion and Auxiliary Power
8. Main Transformer and Smoothing Reactors
9. S7 Electrical Cabinet
10. Handrails
11. Boarding Light I. V. E22 (labeled)
12. Compressor Oil Drain Cock
13. Toilet Drain (labeled)
14. Traction Rods
15. Brake On Indicator (labeled)
16. Auxiliary Equipment Cutout Cock (labeled)
17. Main Air Reservoirs (60,000 cu.in. total) (30,000 cu. in. each)
18. Main Reservoir Outlet Cutout Cock (labeled)
19. Brake Cylinder Cutout Cock "B" End (labeled, for truck cutout)
20. Moisture Indicators (labeled)
21. Air Dryer By-Pass Cock (labeled)
22. Brake Cylinder Cutout Cock "F" End (labeled, for truck cutout)
28. "F" End Label

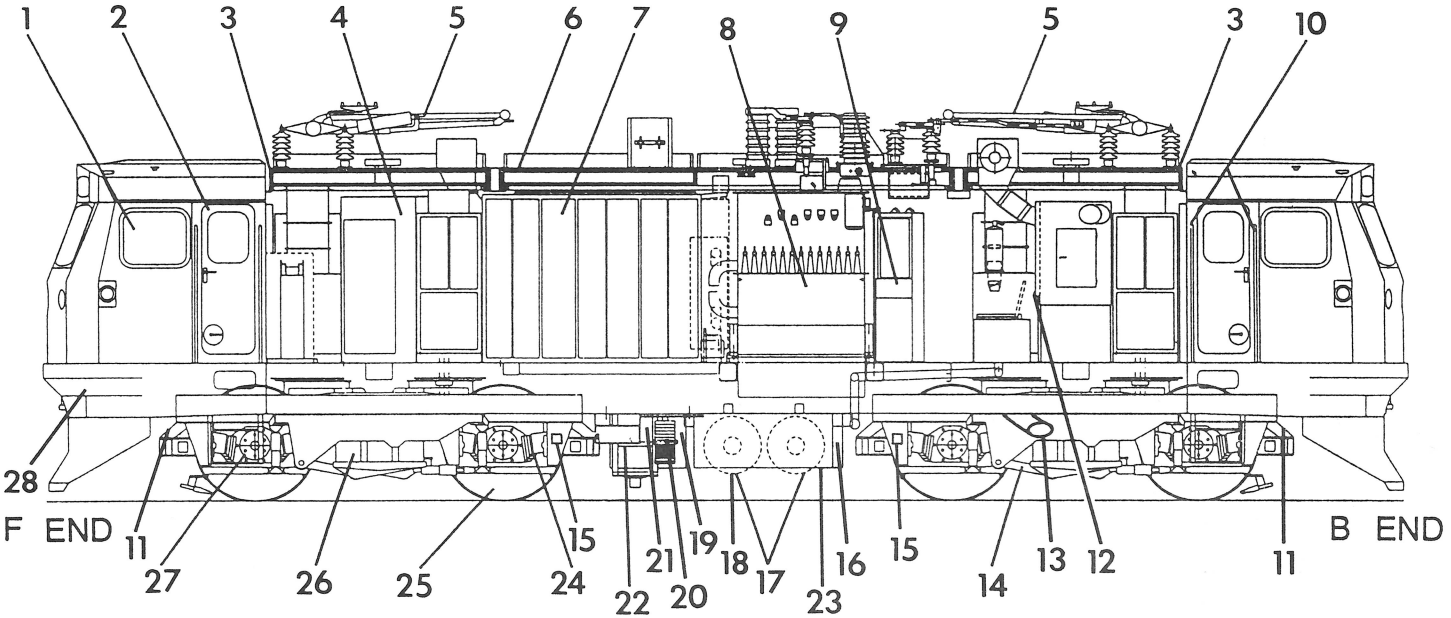

Figure 1-1. ALP-44 General Arrangement (Left Side, Skin Removed)

23. Battery Box
24. Chevrons
25. 51" Diameter Wheels
26. Bolster Springs
27. Spherical Roller Type Journal Bearings
90. Bell
91. Compressor Oil Cooler

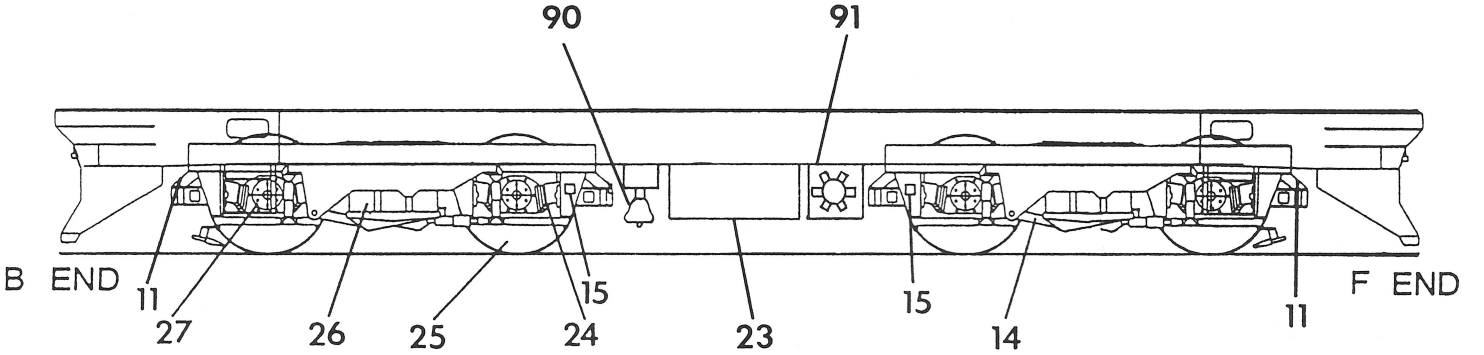

Figure 1-2. ALP-44 General Arrangement (Underframe, Right Side)

29. Radio
30. Engineer Desk
31. Seat
32. Electrical Terminal Cabinet
33. Traction Motor Blower Cabinet
34. Y3 HEP Cabinet
35. Vertical Air Shaft with Air Filter
36. HEP Inverter
37. Radiators
38. Converter DC Link
39. Radiator Blowers
40. HEP Converters
41. Handbrake
42. Y2 Electronic Cabinet
43. Auxiliary Brake Rack
44. Main Brake Equipment Rack
45. Fire Extinguisher
46. Emergency Brake Valves
47. Refrigerator
48. Torpedo and Fusees
49. Air Compressors (Main and Auxiliary)
50. Toilet
51. Traction Motor Converters 1, 2, 3, 4
52. Y1 Cabinet
53. APL Rectifier Unit
54. Traction Motor Field Static Converter
55. APL Inverter
56. ATC Electrical Cabinet
92. Auxiliary Transformer
93. Pantograph Pole
94. AL1 Box

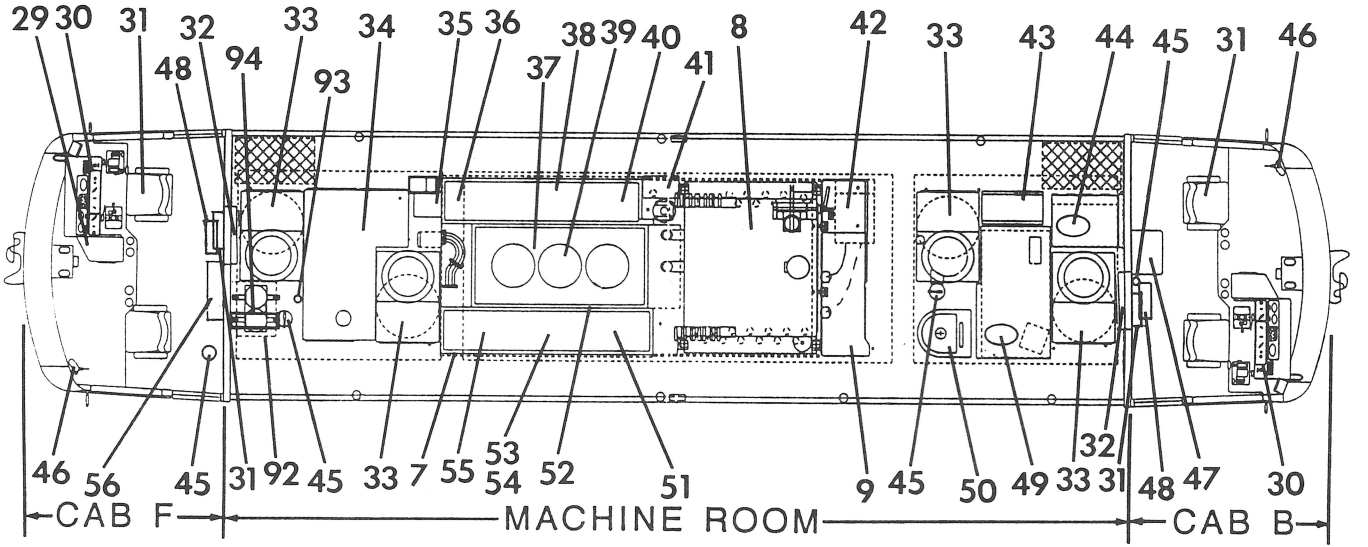

Figure 1-3. ALP-44 General Arrangement (Roof Removed)

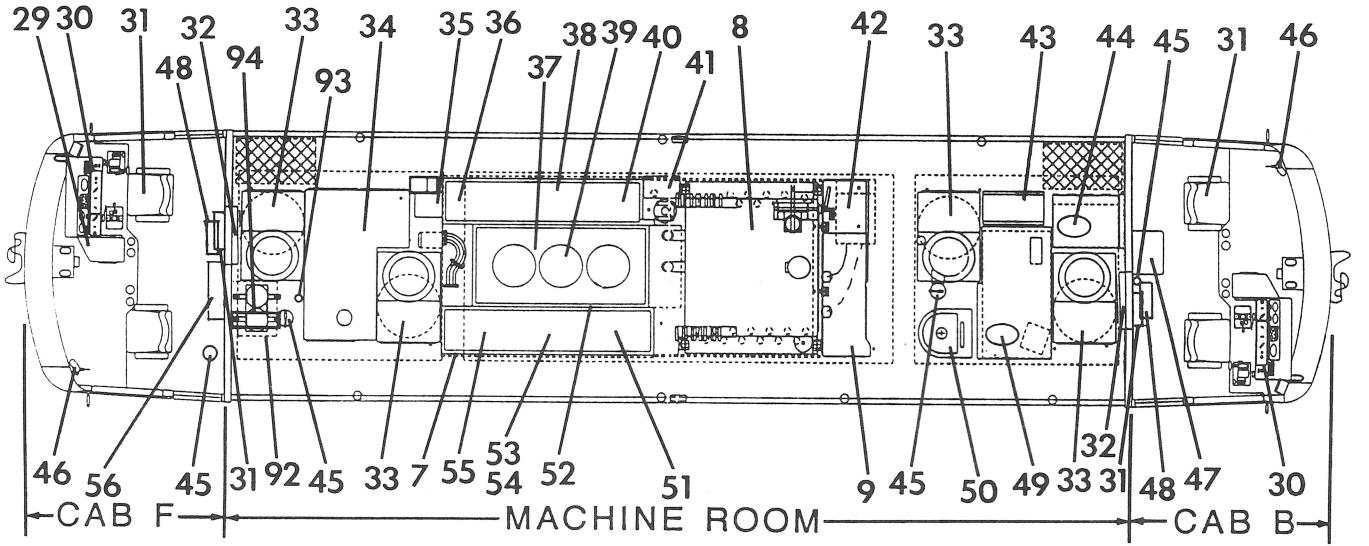

Figure 1-3. ALP-44 General Arrangement (Roof Removed)

57. Strobe
58. Brake Resistors
59. Roof Vent
60. High Voltage Bushing
61. Voltage Sensing Transformer
62. Horn
63.a Roof Hatch (no. 1)
63.b Roof Hatch (no. 2)
63.c Roof Hatch (no. 3)
64. Pantograph Isolation Switch
65. Main Circuit Breaker
66. Lightning Arrestor Disconnect Switch
67. Lightning Arrestor (25kV)
68. Lightning Arrestor (12kV)
69. Pantograph Hold Down Lever
70. Grab Irons
95. Pantograph Grounding Blade and Hold Down Device

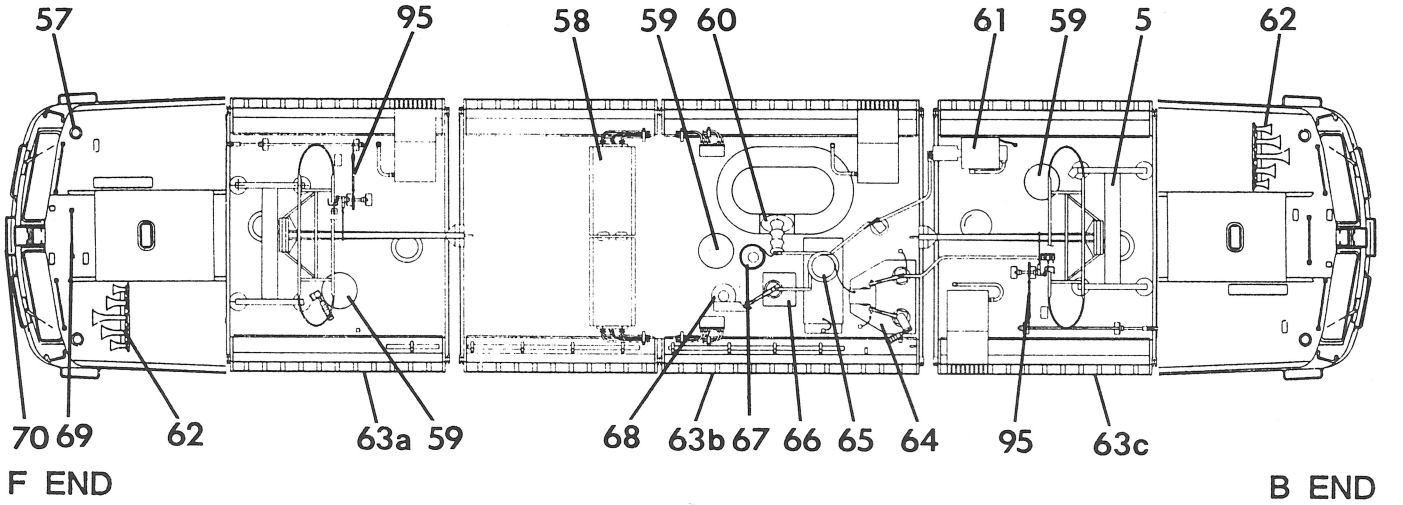

Figure 1-4. ALP-44 General Arrangement (Top View)

71. Number Lights
72. Pantograph Mounting Insulators
73. Grounding/Pantograph Holdown Handle
74. Cab Air Conditioner
75. Grounding/Pantograph Holdown Sign
76. Grounding/Pantograph Holdown Detent
77. Grab Iron
78. Marker Lights
79. Headlights
80. Locomotive Control Receptacle (black)
81. Communications Receptacle (blue)
82. Multiple Unit (MU) Hoses: Application, Actuating, Main Reservoir

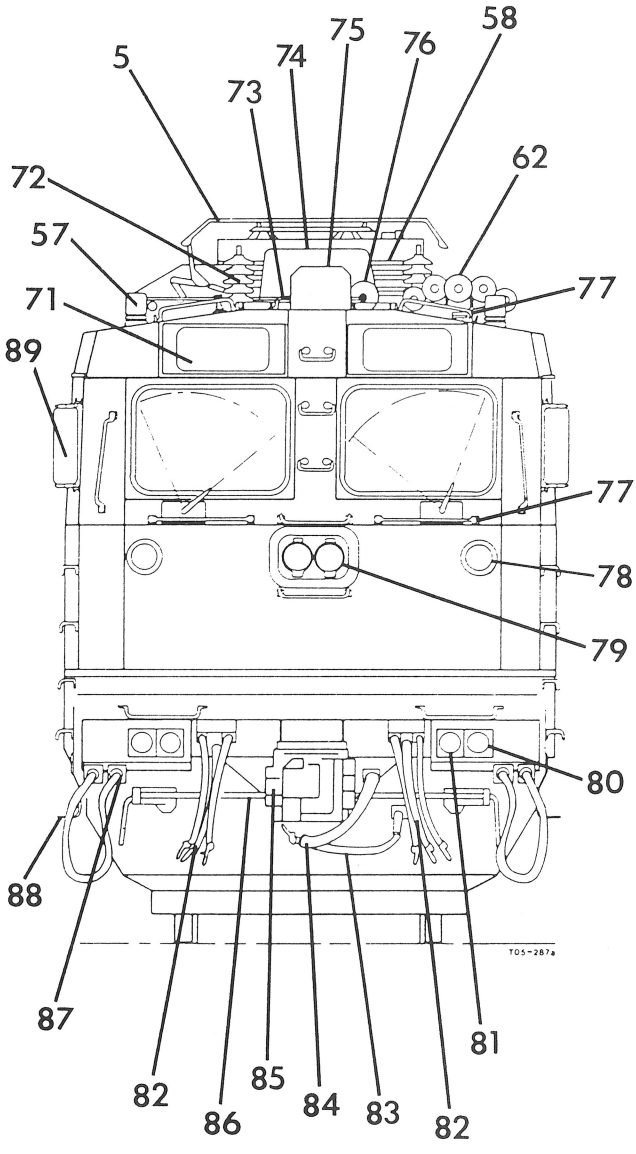

Figure 1-5. ALP-44 Locomotive F End

83. Car Supply Hose (Main Reservoir)
84. Brake Pipe Hose
85. Coupler
86. Uncoupling Lever
87. 480 Volt HEP Receptacle (red)
88. Step
89. Rear View Mirror

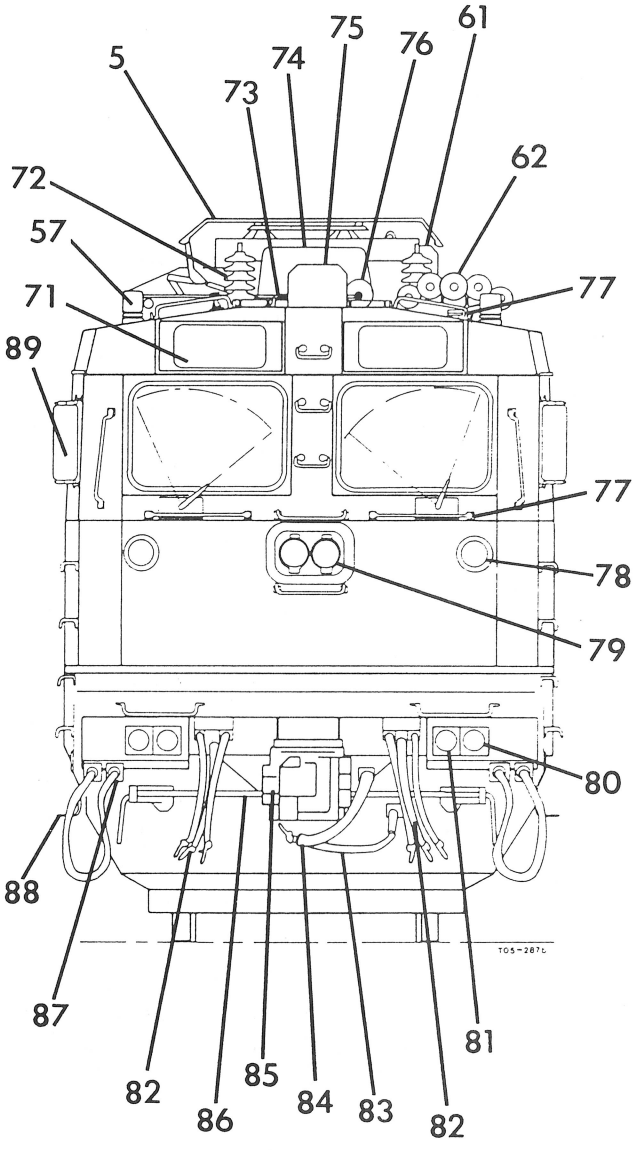

Figure 1-6. ALP-44 Locomotive B End

SYSTEMS

The major systems of the ALP-44 Locomotive include the pantographs, auxiliary power converter, HEP converter, traction motor converters, brakes, wheel slip control, battery, automatic train control, and related components.

PANTOGRAPHS

The locomotive has two pantographs. Each is connected to the main circuit breaker through individual, manually operated isolation switches. Each pantograph has a ground switch/hold down hook on the roof, accessed by climbing the steps between the windshields.

An auxiliary air compressor, located in the equipment room, supplies the air required to raise the pantograph and close the main circuit breaker.

During normal operating conditions, both isolation switches are closed and sealed. In addition, only the trailing pantograph is raised to collect power. During sleet scraping operations, the isolation switch for the leading pantograph is opened and the leading pantograph is raised to scrape sleet from the catenary. Opening the isolation switch to the lead pantograph prevents arcing caused by bouncing.

WARNING: To avoid serious injury, do not operate either pantograph isolation switch unless all of the following conditions are met:

- **One Pantograph Down switch is in the down position**
- **Both pantographs are down**
- **All concerned personnel know that both pantographs are down**

- **The catenary contact wire is at least *five feet* above the lowered pantograph**

AUXILIARY POWER CONVERTER

The auxiliary power converter provides three phase power for the auxiliary equipment, comprising:

- Transformer and thyristor converter cooling oil pump motors
- Traction motor blower motors
- Cabinet blower motors (S7/Y2, Y1/Y3, LS1/LS2)
- Converter radiator blower motors
- Rotary air compressor motor
- Air compressor heat exchanger blower motor
- Thyristor converter internal blower

For normal operation, the auxiliary power source selector is in the APL position. Depending on the operating conditions, power from the auxiliary power system is one of the following:

- Three phase, 440 V, 60 Hz
- Three phase, 220 V, 30 Hz

When propulsion is on, the auxiliary power system operates at three phase, 440 V, 60 Hz. When the main reservoir air pressure is above 135 psi, propulsion is off, and converter oil temperature is below a certain level, the auxiliary power system operates at three phase, 220 V, 30 Hz. There is a 15 minute delay after propulsion is turned off before the system switches to three phase, 220 V, 30 Hz operation.

Auxiliary Power Converter Failure

The auxiliary power converter provides 3 phase power for operation of the auxiliary equipment, comprising of the main air compressor motor, pump motors, and blower motors. If one or more phases of the auxiliary converter fails, the auxiliary converter is disconnected from power in order to protect the motors. Power for the auxiliary equipment can then be taken from the HEP converter. If this happens, the engineer may need to inform train crew to reduce HEP load of the cars.

HEP CONVERTER

The HEP converter supplies the passenger section of the train with 3-phase, 480 V, 60 Hz power for heating, air conditioning, and other passenger conveniences. This system, independent of all other propulsion circuits, may be switched on or off as necessary to provide up to 500 kW of electrical power. This power is transmitted to the cars through two three-conductor jumper cables on each side of the locomotive. All four jumper cables must be installed to provide power to the cars. Lights on the HEP control panel indicate when all jumpers are in place and power is being applied to the cars.

If the auxiliary power converter malfunctions, the HEP converter can supply the locomotive with auxiliary three-phase power. When operated in this manner, it may be necessary to reduce the HEP load of the cars to prevent overloading the HEP converter.

The HEP converter also supplies power for the cab heater blowers.

BRAKES

The locomotive has both dynamic and air braking capability. The air operated system consists of both disc type and tread cleaning brake shoes mounted at each wheel. The disc brakes, bolted into a recess on each side of the wheel, provide most of the air braking. Composition brake pads on each side of the wheel contact the disc when the air brakes are applied.

A tread brake shoe at each wheel provides additional braking and cleans the wheel surface for maximum adhesion between wheel and rail.

When controlled by the automatic brake valve, locomotive braking results in the application of both dynamic braking and air braking. The blended brake system maintains the required level of braking effort by uniformly blending dynamic and air brakes. The system engages automatically whenever the throttle is in idle (0) and the automatic brake valve handle is set to apply the brakes.

The blended brake system makes full use of dynamic brake capability by using the maximum dynamic brake, then supplementing this with air braking. Using dynamic braking during automatic brake operation results in less wear to the tread and disc brake components. Dynamic braking is not available when a traction motor is cut out. However, air braking will increase automatically to compensate for the loss of dynamic brakes.

Dynamic braking is inhibited in an emergency brake application.

WHEEL SLIP CONTROL

The ALP-44 incorporates a two-fold wheel slip control system. One function detects wheel slips and makes corrective action. The second function monitors the amplitude of axle torsional vibrations and regulates power accordingly. Sand may be applied to the rails during these controlling actions. All of these functions are automatic, requiring no action by the engineer.

When high locomotive tractive effort is required, the levels of torsional vibration in the axle can become quite high. The torsional vibrations are measured and power is regulated to limit the amplitude to a reasonable level. Sand is automatically applied to the rails during this controlling action. This action is completely automatic and requires no action by the engineer.

BATTERY

Locomotive lighting and low voltage control systems operate on 74 VDC. An auxiliary transformer supplies alternating current to a thyristor controlled battery charger. The battery charger provides 74 VDC for battery charging and control system power.

AUTOMATIC TRAIN CONTROL/ CAB SIGNAL

The automatic train control system (ATC) is a safety and speed control system that relays appropriate track signal aspects to the engineer's cab and also controls locomotive speed in response to those signals. The system comprises:

- Two aspect display units (ADUs), one mounted in each cab in the center of the engineer desk.
- Control cubicle located in the F cab.
- Four track receivers mounted above the rail, two in each end of the locomotive.
- Speed generator mounted on axle 2.

FIRE EXTINGUISHERS

The locomotive has four 20 pound Sentry fire extinguishers (Model #SY-2014). Each cab has an extinguisher on the helper's side. In the equipment room, one is behind the auxiliary transformer, the other is near the toilet.

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SECTION 2.
CONTROLS AND INDICATORS

INTRODUCTION

The controls and indicators for the ALP-44 locomotive are located in both cabs as well as in the machine room. In each cab, all operating controls, switches, indicators, and alarms are duplicated. The controls and indicators in the machine room are located on the S7 electrical cabinet, the Y2 electronic cabinet, and the Y3 HEP cabinet.

CAB CONTROLS

Figure 2-1 shows the locations of the main control areas in the cab. These include the engineer's desk, indicating light panel, fault and indicator light panel, overhead switch panel, aspect display unit (ADU), F3 cabinet with switch panel, MU-2-A valve, and sand and horn valves.

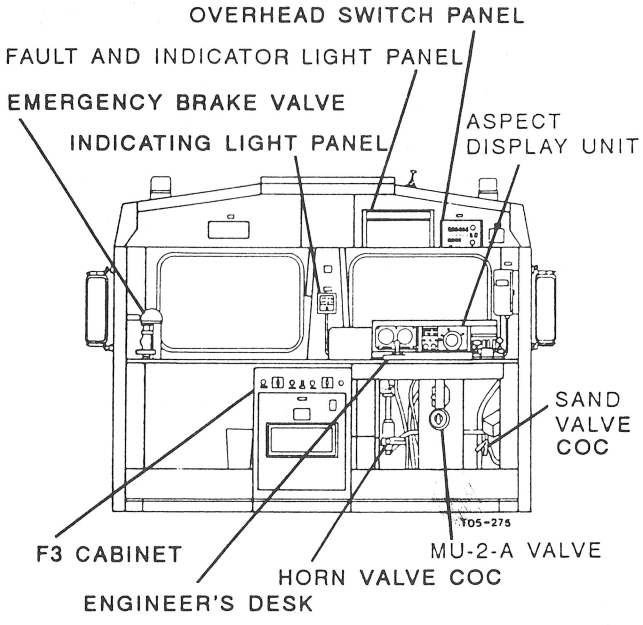


Figure 2-1. Cab Control

The engineer's desk (Figure 2-2) contains the controller, automatic and independent brake valve handles, switch panel assemblies, duplex air gauges, various indicators, radio handset (not shown), Automatic Train Control/Cab Signal ADU (Aspect Display Unit) Alerter, and the voice radio transmitter and receiver (not shown). In each cab, a propulsion reset pushbutton and a head end power reset pushbutton are located on the upper section of the rear cab wall, behind the seat.

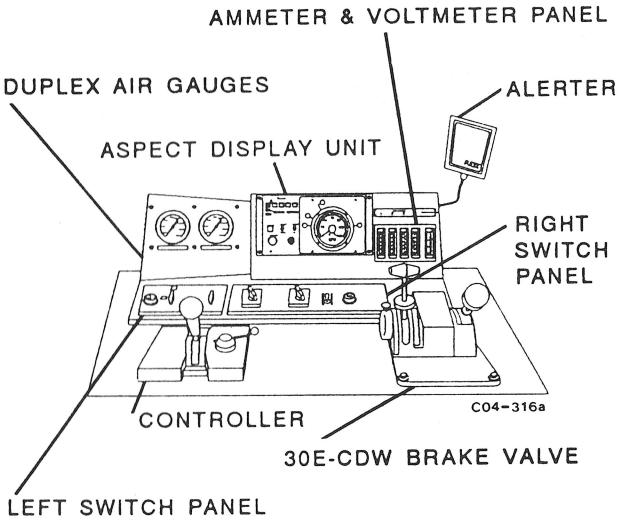


Figure 2-2. Engineer's Desk

INDICATOR LIGHTS, RESETS, AND SWITCH PANELS

Indicator lights and fault resets are arranged in panels within easy reach of the engineer (Figure 2-3). These are:

- Indicating Light Panel
- Overhead Switch Panel
- Fault Reset Push Buttons
- Fault and Indicator Light Panel

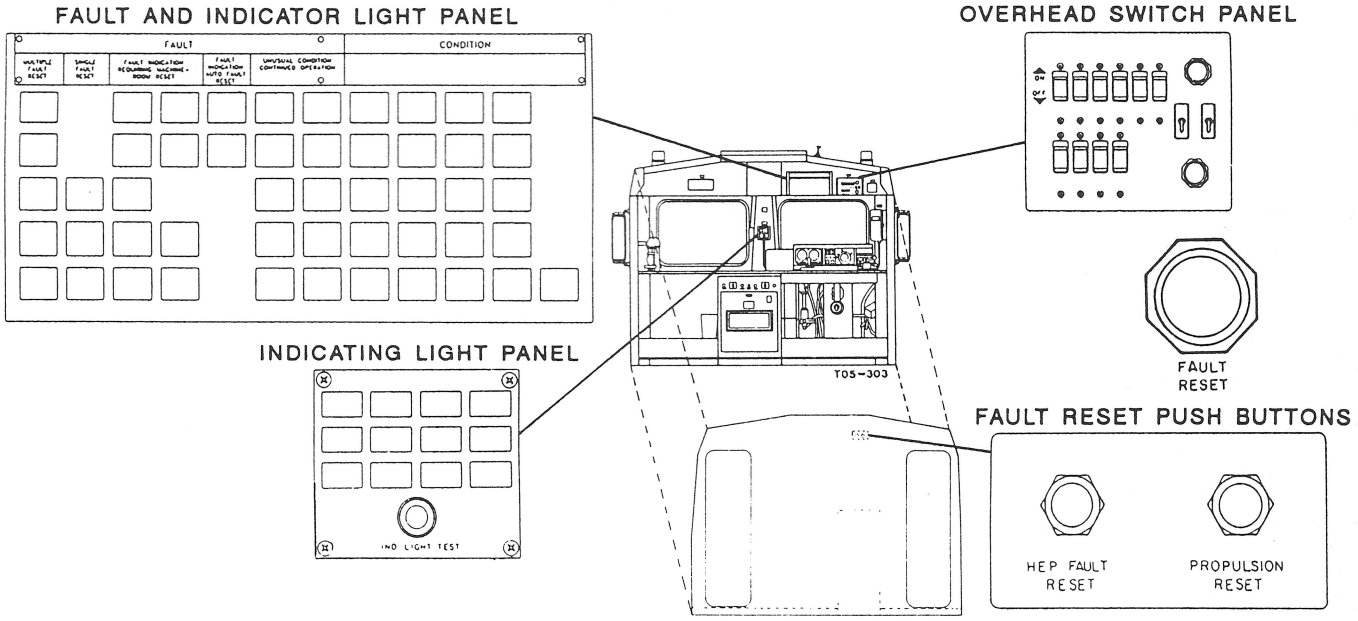


Figure 2-3. Indicator Lights, Resets and Switch Panels

Indicating Light Panel

The indicating light panel, located on the center post, contains 12 lights for monitoring propulsion and braking operating conditions. The panel includes a pushbutton for testing the operation of all lights on the panel (Figure 2-4). The pushbutton also tests the lights on the fault and indicator light panel. Table 2-1 lists the indicator lights and descriptions.

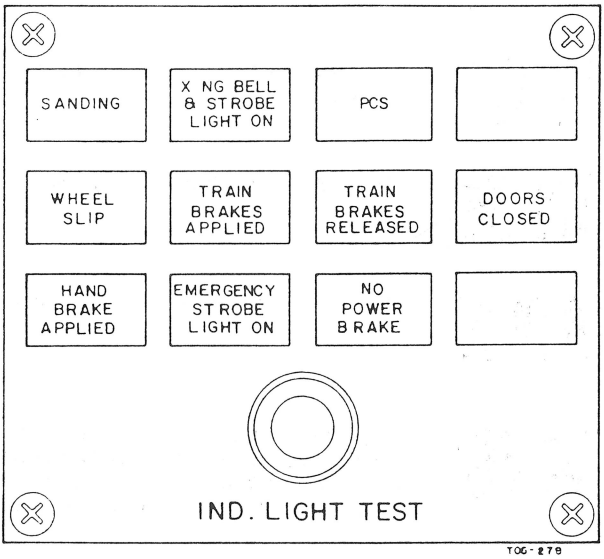
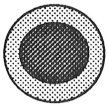


Figure 2-4. Indicating Light Panel

Table 2-1. Indicating Light Panel

SANDING	On when automatically applying sand at leading truck; also when applied with sand pushbutton.
X NG BELL & STROBE LIGHT ON	Locomotive crossing signal bell and white strobe lights are in operation.
PCS	Penalty service or any emergency air brake application; propulsion power is removed.
WHEEL SLIP	Intermittent flashing indicates moderate to severe wheel slip. If light stays on for five seconds and the speed pickup fault light turns on, do not operate the locomotive. The wheels may be locked. Inspect as required.
TRAIN BRAKES APPLIED	All car brakes are applied.
TRAIN BRAKES RELEASED	All car brakes are released.
DOORS CLOSED	All side doors of all cars in the train are closed.
HAND BRAKE APPLIED	Locomotive hand brake is applied.
EMERGENCY STROBE LIGHT ON	Strobe light on the roof is in operation.
NO POWER BRAKE	Independent or automatic brakes are applied (approximately 20 psi B.C.) with throttle in motoring zone P1 through P9. Propulsion power is automatically cut off.
	Pressing the indicating light test pushbutton with the reverser in the F, N, or R position turns on all indicating lights for a light test.

WHITE AMBER GREEN RED

Desk and Cabinet Switch Panels

Left and right switch panel assemblies, located on the engineer's desk, contain switches and controls for lighting, sanding, power source, and lowering the pantograph (Figures 2-5 and 2-6). For more information see "Lighting Controls" and "Supply Voltage Controls" later in this section.

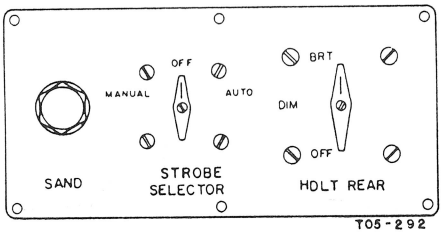


Figure 2-5. Left Switch Panel Assembly

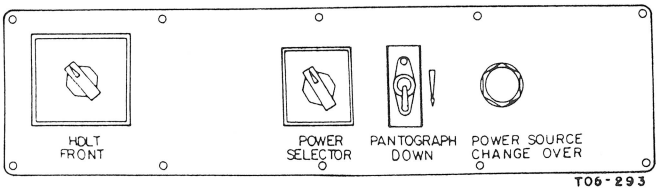


Figure 2-6. Right Switch Panel Assembly

The F3 switch panel on the F3 cabinet has a separate windshield wiper control valve for the wipers on both the engineer's side and the helper's side of the cab (Figure 2-7). Each side of the cab also has separate cab heater controls. In addition, the panel has two 74 VDC receptacles which receive power when the battery switch and circuit breaker for the lights are closed. The MU toggle switch turns off the headlights for cabs facing each other during MU operation.

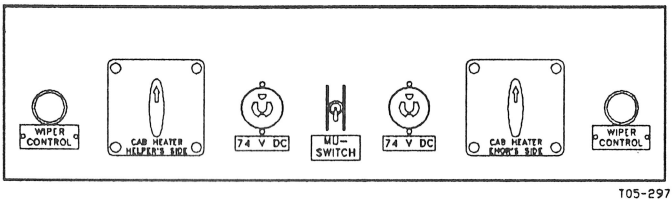


Figure 2-7. F3 Cabinet Switch Assembly

Overhead Switch Panel

This panel is on the front wall of each cab, directly above the desk (Figure 2-8). It contains switches for the boarding lights, number lights, marker lights, cab lights, gauge lights, desk light, and machine room lights. These lights are on when the switches are in the up position. For more information see "Lighting Controls" later in this section.

The windshield heater switch controls defrosting and de-icing. The conductor signal pushbutton is for conductor/engineer communication.

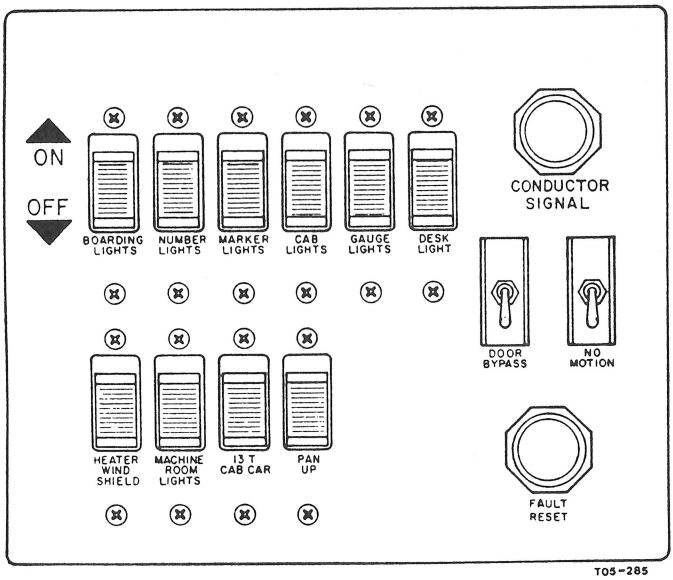


Figure 2-8. Overhead Switch Panel

See "Supply Voltage Controls" for information on the 13T Cab Car and Pan Up Switch.

See "Door Controls" for information on Door Bypass and No Motion toggle switches.

The Fault Reset pushbutton allows the engineer to reset faults from the cab. If a fault develops, a light on the fault and indicator light panel turns on and the light in the Fault Reset flashes until the fault is reset or power is removed. See "Fault and Indicator Light Panel" for more information.

Rear Wall Pushbuttons

Behind the engineer's seat on the rear are the Propulsion and HEP Fault Reset Pushbuttons. The HEP Fault Reset pushbutton resets a HEP fault. The Propulsion Reset Pushbutton resets a propulsion fault. For more information, see "Operating the Locomotive, Unusual Conditions" in Section 3, as well as applicable entries in Section 4.

FAULT AND INDICATOR LIGHT PANEL

Indicating lights on the fault and indicating light panel help an engineer to monitor locomotive faults and operating conditions (Figure 2-9). The lights are controlled by fault detecting relays located in the S7 electrical cabinet or in the Y3 HEP cabinet in the machine room. Some fault detecting relays may be reset by pressing the flashing FAULT RESET pushbutton on the overhead switch panel. For operating information, see "Using the Fault and Indicating Light Panel" in Section 3.

The indicating lights are divided into five fault groups and one condition group. Some of the indications are duplicated on the HEP control panel in the machine room. The duplicated indications are marked by an asterisk in "Responding to the Fault and Indicator Lights."

The Multiple Fault Reset Group

The Multiple Fault Reset Group includes:

- Transformer primary overload
- Traction motor overload
- Traction motor armature ground
- Dynamic brake overload
- HEP overload indications

When a multiple fault reset indicating light turns on, the following occurs:

1. Main circuit breaker opens or HEP is disconnected from the cars.
2. Alarm bell sounds.
3. The light in the FAULT RESET pushbutton on the overhead sliding switch panel assembly flashes until reset.
4. The applicable fault indicator of the multiple fault reset group turns on.

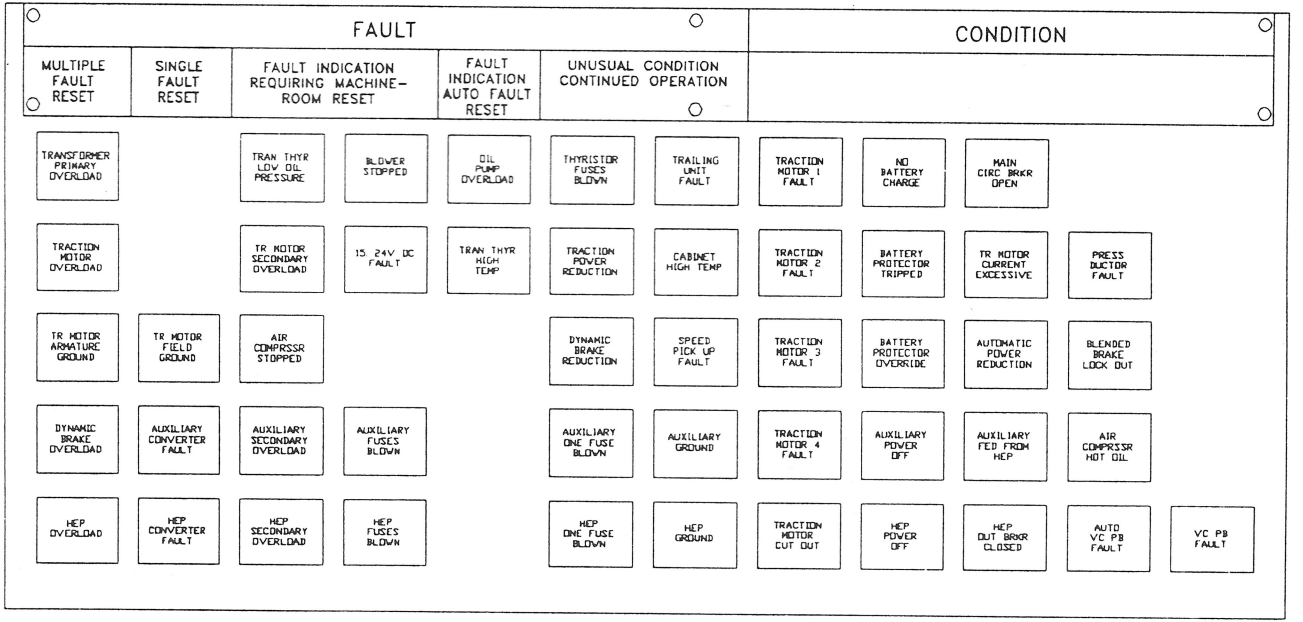


Figure 2-9. Fault and Indicator Light Panel

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The Single Fault Reset Group

The Single Fault Reset group includes:

- Traction Motor Field Ground
- Auxiliary Converter Fault
- HEP Converter Fault

When an indicator in this group turns on, the engineer may be able to reset once from the cab. However, these usually require an inspection of the machine room for the cause of the fault.

Fault Indication Requiring Machine Room Reset Group

This group includes:

- Transformer/Thyristor Low Oil Pressure
- Traction Motor Secondary Overload
- Air Compressor Stopped
- Auxiliary Secondary Overload
- HEP Secondary Overload
- Blower Stopped
- 15, 24VDC Fault
- Auxiliary Fuses Blown
- HEP Fuses Blown

All of these indicators, except AIR COMPRESSOR STOPPED, show that either the main circuit breaker has opened or that the auxiliary, HEP, and propulsion systems have shut down. The air compressor indicator comes on when the compressor stops supplying air to the system. These usually require an inspection of the machine room for the cause of the fault.

Fault Indication Automatic Fault Reset Group

This group includes:

- Oil Pump Overload
- Transformer/Thyristor High Temperature

These faults reset automatically when the fault condition clears. The flashing light in the FAULT RESET pushbutton goes out after all of the following conditions are met:

- The fault indicating light has gone out
- The engineer has set the throttle to 0 position
- The engineer has pressed the FAULT RESET pushbutton on the overhead sliding switch panel assembly

Unusual Condition Continued Operation Group

This group includes:

- Thyristor Fuses Blown
- Traction Power Reduction
- Dynamic Brake Reduction
- Auxiliary One Fuse Blown
- HEP One Fuse Blown
- Trailing Unit Fault
- Cabinet High Temperature
- Speed Pick-Up Fault
- Auxiliary Ground
- HEP Ground

An engineer cannot reset these faults. However, locomotive operation may continue, with some instances causing automatic power reductions.

Condition Group

The Condition Group includes:

- Traction Motor 1 Fault
- Traction Motor 2 Fault
- Traction Motor 3 Fault
- Traction Motor 4 Fault
- Traction Motor Cut Out
- No Battery Charge
- Battery Protector Tripped
- Battery Protector Override
- Auxiliary Power Off
- HEP Power Off
- Main Circuit Breaker Open
- Traction Motor Current Excessive
- Automatic Power Reduction
- Auxiliary Fed From HEP
- HEP Out Breaker Closed
- Pressductor Fault
- Blended Brake Lockout
- Air Compressor Hot Oil
- Auto VC/PB Fault
- VC/PB Fault

These indications are mainly of informative nature, but some indicate faults that cannot be reset on the road. Certain fault conditions open the main circuit breaker to disconnect all power from the high voltage circuits. This causes the Main Circuit Breaker Open indicator on the fault and indicating light panel to turn on.

When the main circuit breaker opens for any reason, the No Battery Charge and Auxiliary Power Off indicators also turn on. If the HEP isolation switch is in the RUN TL position when the main circuit breaker opens, the HEP Power Off indicator also turns on.

The No Battery Charge, Auxiliary Power Off, and HEP Power Off indicators do not necessarily indicate a fault in these systems. These indicators turn on automatically when input power from the catenary is disconnected.

ENGINEER PROPULSION CONTROLS

Propulsion controls include the controller, indicating light panel, ADU, acknowledge foot switch, and alerter (Figure 2-10). For more information on the indicating light panel, see "Indicator Lights, Resets, and Switch Panels." The other propulsion controls are described below.

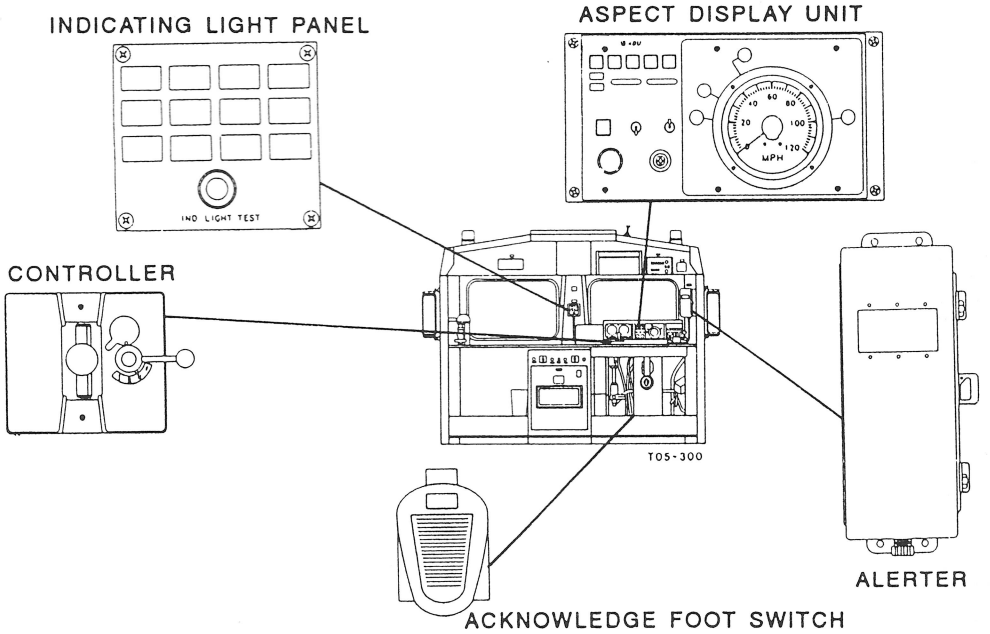

Figure 2-10. Engineer Propulsion Controls

Controller

The controller, located on the engineer's desk, has two operating handles: the throttle and the reverser (Figure 2-11). The throttle handle controls locomotive power in both motoring and dynamic braking operating modes. The reverser determines locomotive direction and movement.

Moving the throttle handle backward controls power during the motoring mode of operation; forward, controls power during dynamic braking.

The throttle has three functional positions:

- Neutral position 0 (detent)
- Motoring positions P1 through P9 and F
- Braking position B1 through B9 and F

The engineer must move the throttle out of the detent 0 position before moving it forward or backward. Motoring zone positions P1 through F and B1 through F are stepless control zones. Pulling back the throttle from 0 to P1 through F increases tractive effort. Pushing the throttle forward from 0 to B1 through F increases braking effort.

The reverser handle is located to the right of the throttle. It has four detent positions:

- F (forward)
- N (neutral)
- R (reverse)
- I (isolate)

Neutral (N) is used when the locomotive is at standstill and the controls are being attended. The I position de-energizes control system functions to prevent locomotive movement. It is used when the locomotive is unattended or when changing operating ends.

The engineer cannot move the reverser handle unless the throttle is in 0 position. Also, this position allows the engineer to remove the reverser handle.

Forward and reverse directions are determined by the operating cab. When the engineer moves the handle toward the front of the cab (F), circuits are set up for the locomotive to move forward. When the engineer moves the handle toward the rear of the cab (R), the locomotive is ready to move in reverse.

With the reverser in the neutral position (N), most locomotive control circuits remain energized. However, the following are not energized and do not have locomotive power:

- Forward relay (FOR)
- Reverse relay (RER)
- Motoring relay (MR)
- Braking relay (BR)

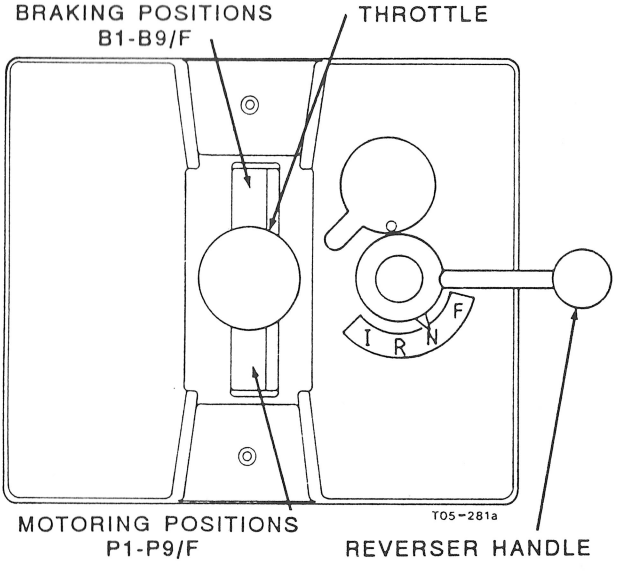

Figure 2-11. Controller

Aspect Display Unit

The Aspect Display Unit (ADU) indicates locomotive speed conditions and provides controls for responding to those conditions (Figure 2-12). The speedometer indicates speed in miles per hour (mph) whether or not the locomotive is in cab signal territory. The four signal aspects around the speedometer reflect the permissible speeds set by the ATC. When in M&E territory, the M&E territory light is lit, signifying that there is no cab signal. The Territory switch sets the system for coded or non-coded territory. The Overspeed indicator lights when the locomotive exceeds the speed set by the cab signal system. ATC Cutout lights when the locomotive is not controlled by the automatic train control.

During departure testing (Dept Test High/Low switch), the Dept Test indicator is on. The cab signal test switch tests the cab signal equipment at the HIGH and LOW levels of rail current. When the Dept Test switch is in HIGH, the automatic test generates each of the four signal aspects and verifies the corresponding overspeed set points. The LOW setting performs a less comprehensive test.

The Recorder Failure light is on when the recorder is malfunctioning. The Application light is on when a penalty brakes is applied; the Suppression light is on when a penalty brake is suppressed.

The main control on the ADU is the ATC (Cab Signal) Acknowledgement/Alerter Control reset pushbutton. Pressing this pushbutton acknowledges a downward change to a more restrictive cab signal aspect and, in the event of an exceeded warning time limit, resets the alertness control system.

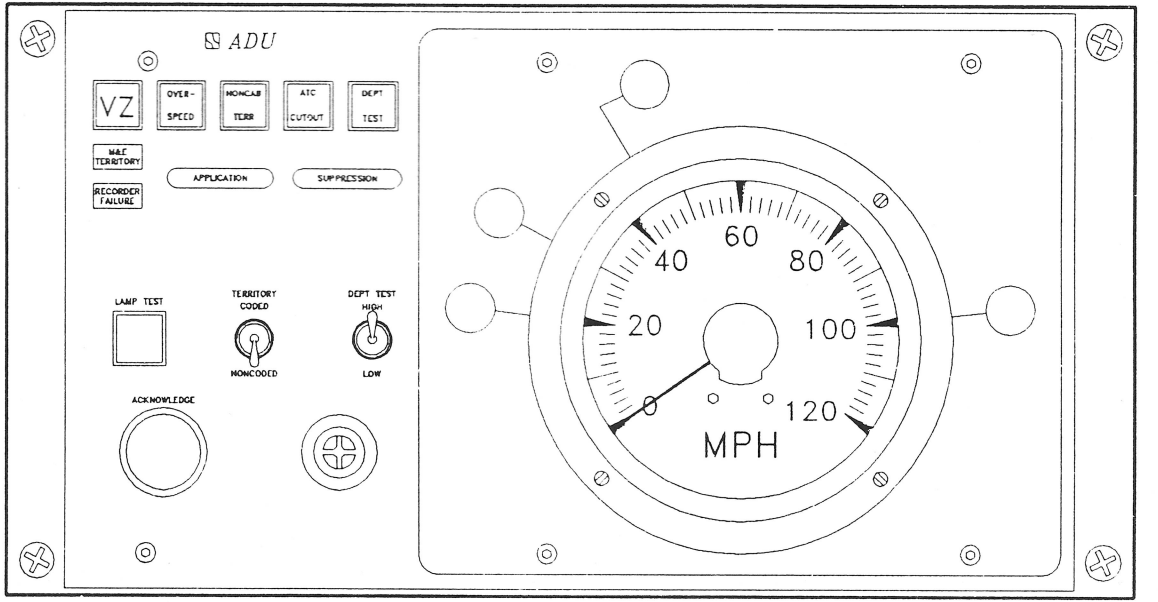

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Figure 2-12. Aspect Display Unit

The operator must reduce train speed when the maximum speed indicated by the cab signal system is exceeded. The overspeed indicator turns on if the maximum speed indicated by the new signal is being exceeded. Failure to acknowledge the more restrictive signal and apply brakes to reduce speed causes the train control system to automatically initiate a penalty brake application.

The Velocity Zero (VZ) light is illuminated when the locomotive is not moving.

NJT operating instructions for the train control system are not provided in this manual; observe railroad operating instructions concerning this system.

Alerter

The Alerter monitors the engineer's actions and requests acknowledgement at various times during locomotive operation. Failure to acknowledge reduces the power to 0 and applies the brakes at a full service penalty rate.

Alarm Bell

In the F3 cabinet between the engineer's and helper's seats, each cab has an alarm bell to alert the engineer to certain operating conditions (Figure 2-13). The alarm circuit is trainlined so that the bell rings in all units in a consist. It will ring whenever:

- The main circuit breaker is open
- Faults occur in the HEP system
- Faults occur in a trailing locomotive

During a fault condition, the engineer can silence the alarm bell by pressing the Fault Reset pushbutton on the overhead switch panel assembly. The alarm circuit automatically resets when the fault circuit is reset.

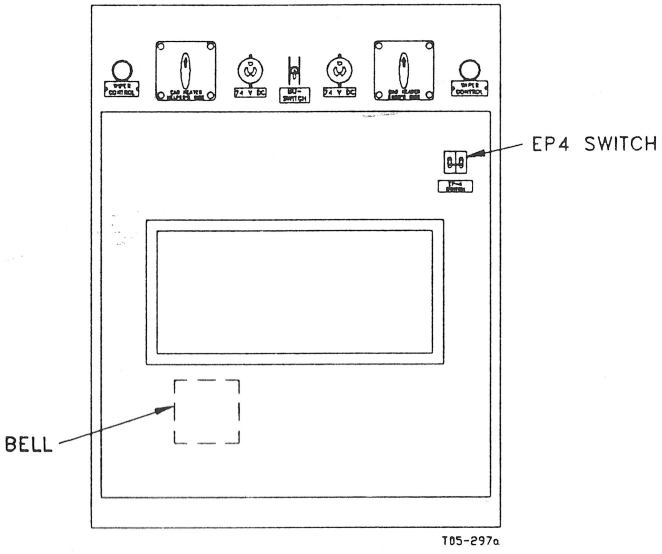

Figure 2-13. F3 Cabinet

Acknowledge Foot Switch

The foot switch provides another means of alerter acknowledgement for the engineer.

Sand Pushbutton

The Sand pushbutton operates the sanding magnet valves for applying sand in the direction of locomotive travel. The electrical control of sanding is trainlined for control throughout the consist.

AIR BRAKE CONTROLS

Figure 2-14 shows the cab-mounted air brake controls, which include:

- Indicating Light Panel
- 30E-CDW Brake Valve which includes:
  - Automatic Air Brake Valve
  - Independent Air Brake Valve
  - Cut-off Pilot Valve
- MU-2-A Valve
- Emergency Brake Valve (located on the helper's side of the cab)
- EP-4 Switch
- Duplex Air Gauges

See "Indicator Lights and Resets" for information on the Indicating Light Panel.

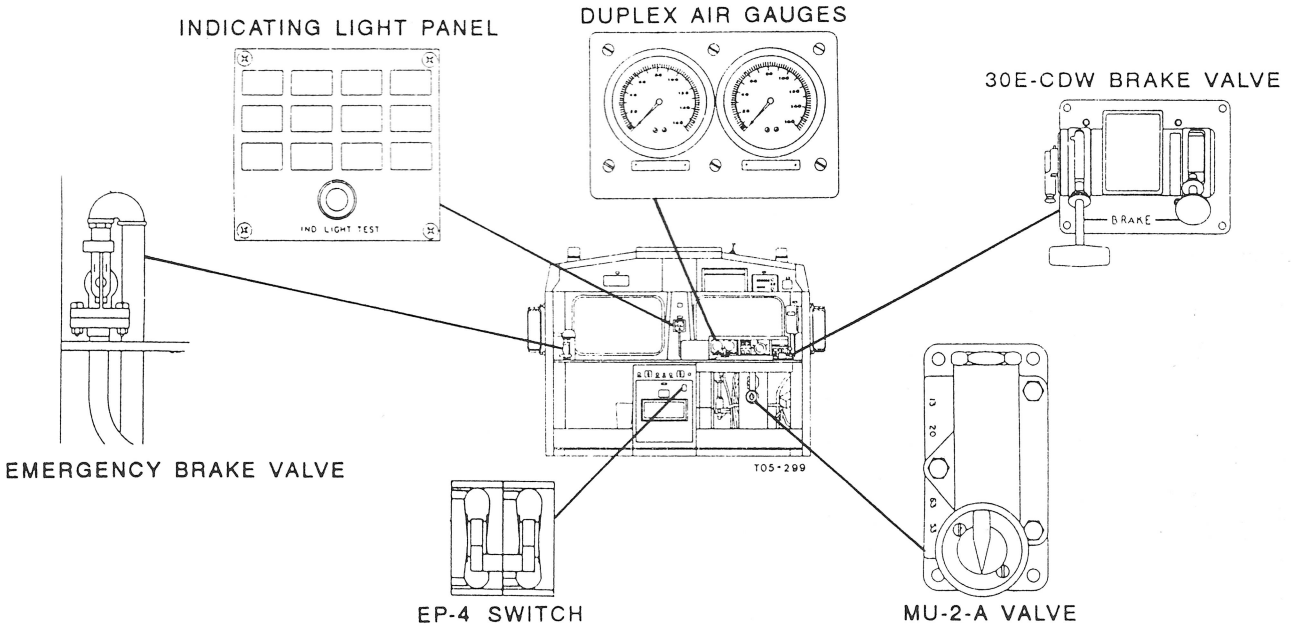

Figure 2-14. Air Brake Controls

Automatic Brake Valve

The automatic brake valve controls the application and release of both locomotive and train brakes (Figure 2-15). The brake valve is a non-self-lapping pressure maintaining type valve, used for holding brake pipe reductions constant against nominal brake pipe leakage. Its positions are:

- Release
- Hold
- LAP
- Service
- Handle Off (HO)
- Emergency

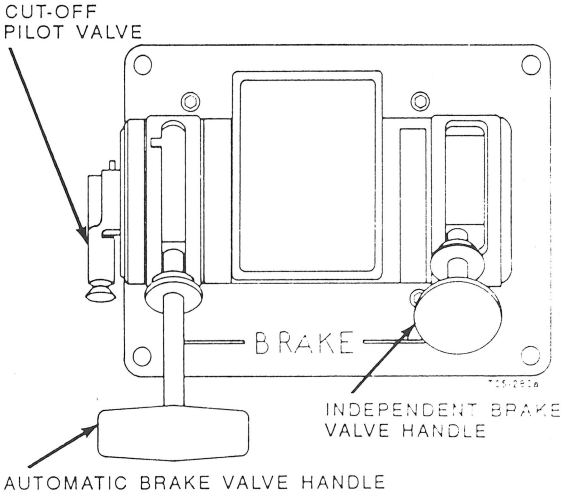

Figure 2-15. 30E-CDW BRAKE VALVE

Release charges the brake pipe and releases the train brakes. Hold also recharges the brake pipe to its full pressure and provides for electric hold of the brakes on the train. Service reduces equalizing reservoir pressure at the service rate and LAP stops any further pressure reduction of the equalizing reservoir.

Handle Off is the position in which the automatic brake valve can be cut out via the cut-off pilot valve. The handle must be in this position in any non-operating cab (with the automatic brake valve cut out). Emergency provides an emergency brake application.

Independent Brake Valve

Located to the right of the automatic brake valve, the independent brake valve provides independent control of locomotive braking. It also allows the engineer to "bail off" an automatic brake application, if necessary, for proper train handling. Its positions are:

- Release
- Application Zone
- Full Application

Release is the normal operating position, removing pressure from the brake cylinder. The application zone allows the engineer to increase or decrease brake cylinder pressure on the locomotive. Full application provides maximum brake cylinder pressure on the locomotive.

Cut-off Pilot Valve

Located on the left side of the 30E-CDW brake valve housing, this valve has two positions: IN and OUT. When the engineer in the front cab of the leading locomotive turns this valve to IN, it allows the automatic brake valve to operate. OUT cuts out the automatic brake valve as well as the pressure maintaining function of the automatic brake valve.

MU-2-A Valve

Located under the engineer's desk on the cab front wall (both cabs), this valve has two positions (Figure 2-16):

- LEAD - DEAD
- TRAIL 24-26

It is turned to LEAD-DEAD in the front cab of the lead locomotive. TRAIL 24-26 cuts out the independent brake valve in non-operating cabs. This system allows full control of the air brake system from the brake valves in the lead cab.

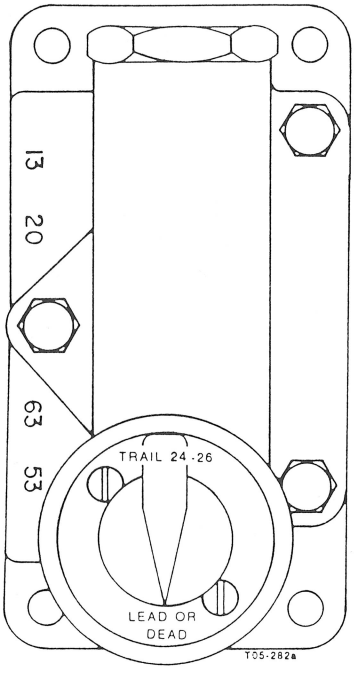

Figure 2-16. MU-2-A Valve

Emergency Brake Valve

The emergency brake valve is located on the front wall on the helper's side of the cab. It allows the helper to initiate an emergency application, if necessary.

EP-4 Switch

The Electric Pneumatic switch, located in the F3 cabinet, is an on/off switch for determining which cab has control of recharging the equalizing reservoir when the automatic brake valve handle is in the HOLD position. It also sets up the application, release, and hold trainline wires for the transmission of electrical signals from the lead cab to the rest of the train. (For location, see Figure 2-13 earlier in this section).

Bell Valve

The bell valve to the right of the engineer's seat actuates automatically when the horn is blown. The engineer can also pull the valve to make the bell ring.

Horn

The horn is controlled by the rope hanging in the cab to the engineer's upper right and the fireman's upper left. Pulling it releases air to the horn on the roof. It is also controlled by the horn foot switch (Figure 2-17), located on the floor under the desk.

Duplex Air Gauges

Two duplex gauges, located along the top of the engineer's desk, indicate air pressures concerned with the air brake equipment. One gauge indicates main reservoir and equalizing reservoir pressures. The other gauge indicates brake cylinder and brake pipe pressures.

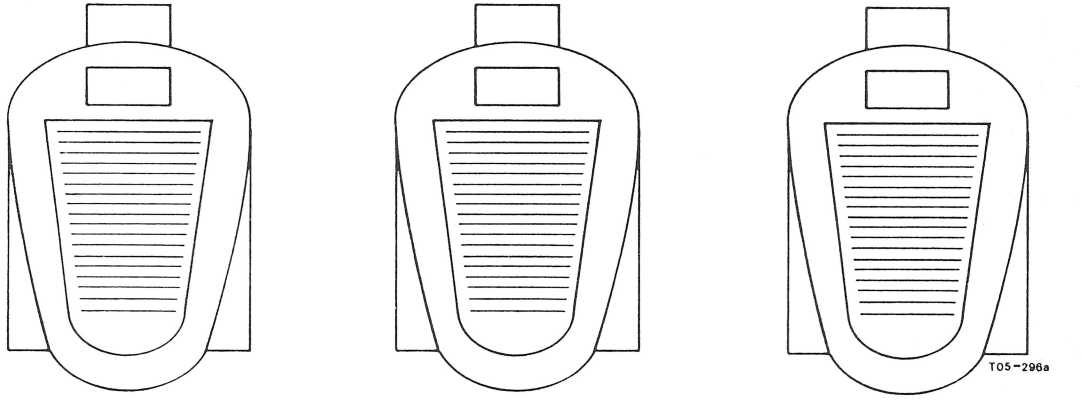

Figure 2-17. Foot Switches

Air System Valve and Switch Positions

Most of the controls in one cab are independent of the corresponding controls in the opposite cab. However, several switches in both cabs must be properly positioned in order to operate the locomotive. Air system valve and switch positions for different types of operation are provided in Table 2-2 on the following page.

Table 2-2. Air System Valve and Switch Positions

VALVE or CONTROL	AUTOMATIC BRAKE VALVE CUT-OFF PILOT VALVE	MU-2-A VALVE Each Cab)	AUTOMATIC BRAKE VALVE HANDLE	INDEPENDENT BRAKE VALVE HANDLE	DEAD ENGINE FEATURE CUTOUT FEATURE COCK (On Air Brake Rack)	SAFETY CONTROL CUT-OUT COCK (On Air Brake Rack)	TRAIN CONTROL CUT-OUT COCK (On Air Brake Rack)
Operating Cab (Single, Lead, or Push-Pull)	IN	IN	As Required	As Required	OUT	IN	IN
Non-operating Cab Lead-Trail or DoubleHead Locomotive	OUT	OUT	Handle Off	Release	OUT	IN	IN
Double Head Operating Cab	OUT	IN	Handle Off	Release	OUT	IN	IN
Push-Mode (Push-Pull Consist)	OUT	IN	Handle Off	Release	OUT	IN	IN
Dead in Train/Towed	OUT	IN	Handle Off	Release	IN	OUT	OUT

SUPPLY VOLTAGE CONTROLS AND INDICATORS

Supply voltage controls and indicators monitor voltage coming in off the catenary, measure the current in the traction motors, and control the pantograph, and provide power to cab cars (Figure 2-18).

When on, the 13T Cab Car switch, located on the overhead switch panel assembly, provides a cab car with control of +74 VDC during push/pull operations. (In a consist, the lead locomotive controls the consist).

On the same panel, the Pan Up switch provides power for raising the pantograph. When in the up position, it raises the pantograph. When released, the switch returns to its original position. The Pantograph Down Switch, located on the Right Switch panel, lowers the pantograph.

WARNING: Before raising pantograph, make sure that the pantographs are not grounded. See procedures in Section 3, "Operating the Locomotive."

Ammeter and Voltmeter Panel

Five vertical indicators on the engineer's desk provide power supply information. The meter on the far right indicates kilovolts coming in off the catenary; the other four measure amps in the traction motors. The indicators have green, yellow, and red areas. Green indicates 0-1300 amps; yellow indicates 1300-1450 amps; red is 1450 - 2500 amps. If maximum load current becomes greater than 1450, automatic power reduction occurs to avoid overheating the traction motors.

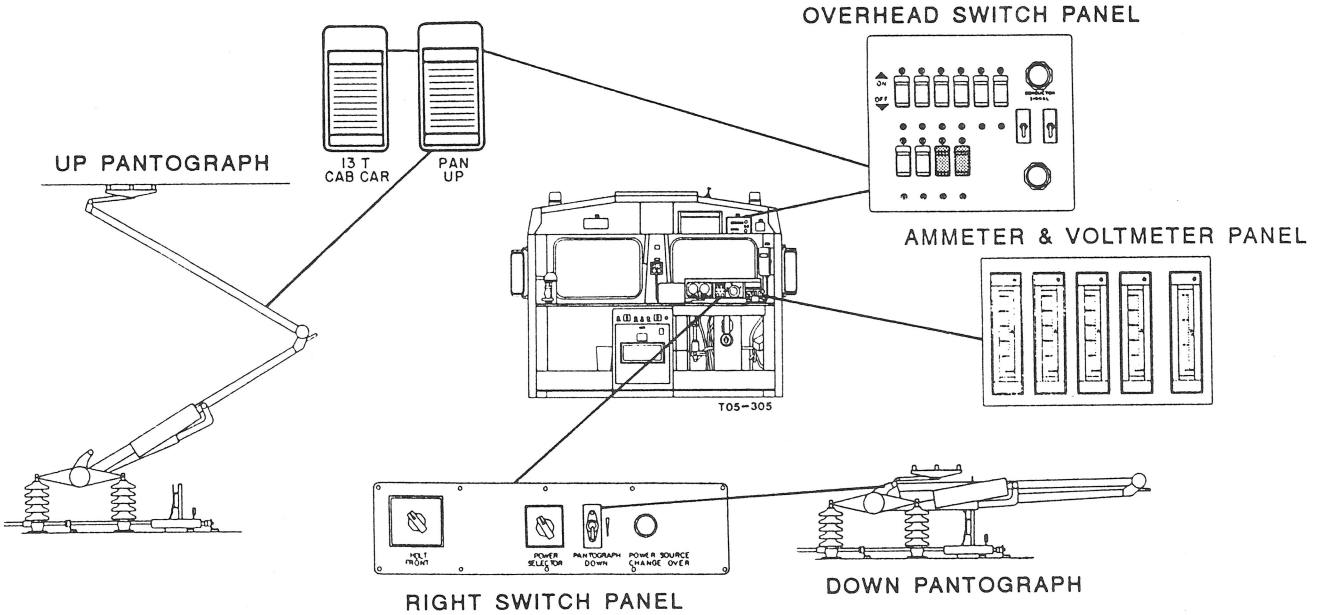

Figure 2-18. Supply Voltage Controls & Indicators

Power Source Change Over

The Power Source Change Over pushbutton, located on the right switch panel, opens the main circuit breaker so an engineer can manually select the power source voltage during phase breaks. It is used with the Power Source Selector switch.

When the VC/PB Auto switch on the S7 cabinet is off, these controls are used to manually change voltages to match incoming voltage. The voltage sensing transformer, located on the roof, prevents the main circuit breaker from operating if measured voltage/frequency does not correspond to the selected powering mode.

When the VC/PB Auto switch (S7 cabinet) is on, the VC/PB system automatically reconfigures the locomotive as it enters sections with different catenary voltage and frequency.

Power Selector

The power selector switch, also located on the right switch panel, selects the correct voltage/frequency combination (11kV, 12.5kV, or 25kV) for continued operation. This selector is used with the VC/PB switch when negotiating phase breaks or voltage /change-over sections of the catenary. The selector functions only when the VC/PB Auto switch is off.

NOTE: Observe NJT operating instructions concerning this system.

COMMUNICATIONS

The radio and conductor signal allow an engineer to maintain communications with the conductor, passengers, and stations (Figure 2-19).

Radio

Each ALP-44 operator's cab is equipped with an AL-1700 type radio. This is a solid state, synthesized, 45/25 watt locomotive transceiver manufactured by Aerotron to meet AAR "Clean Cab" requirements. It also serves as a public address (PA) and intercom (IC) system. See Section 3 for operating information.

Conductor Signal

To notify the conductor, the engineer presses the conductor signal on the Overhead Switch Panel.

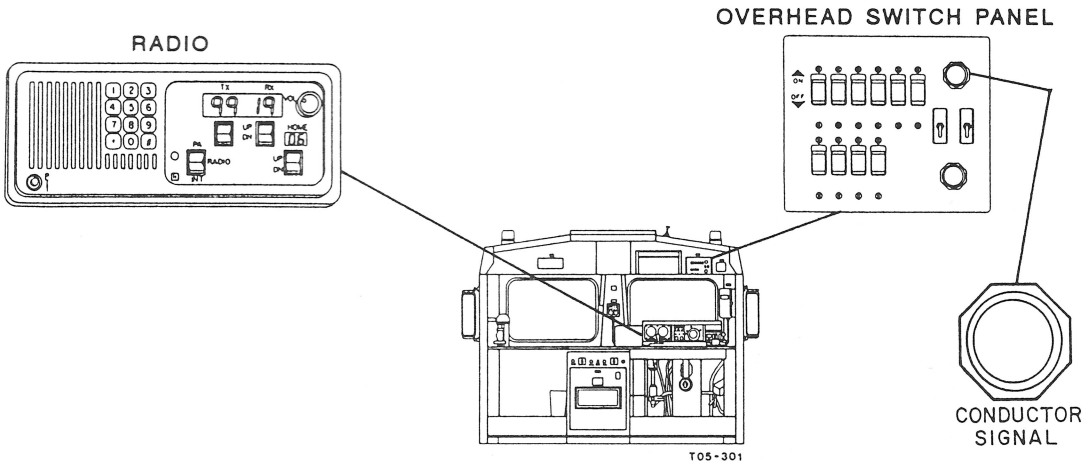

Figure 2-19. Communications

LIGHTING CONTROLS

Figure 2-20 shows the locations of the exterior lighting controls.

Headlight Switches

The two 3-position rotary snap switches in each cab provide independent control of the front and rear headlights. The right switch panel has the front headlight control; the left switch panel has the rear headlight control. Each switch has Off, Dim, and Bright positions. The front and rear designations are determined by the cab in which the controls are located.

Strobe Selector

The strobe lights operate only on the end having the reverser handle in the F, N, or R position. The Strobe Selector on the left switch panel has three positions: Auto, Off, and Manual. The twin white strobe lights are controlled by the position of the headlight switch (see Headlight Switches). When the headlight switch is set to OFF, the twin strobes are off.

When the headlight switch is set to DIM or BRIGHT and the strobe selector is set to MANUAL, the twin white strobe lights operate continuously.

When the headlight switch is set to DIM or BRIGHT and the strobe selector is set to AUTO position, the white strobe lights operate whenever the crossing bell is on.

The MU toggle switch turns off the headlights for cabs facing each other during MU operation.

Figure 2-21 shows the location of the interior lighting controls.

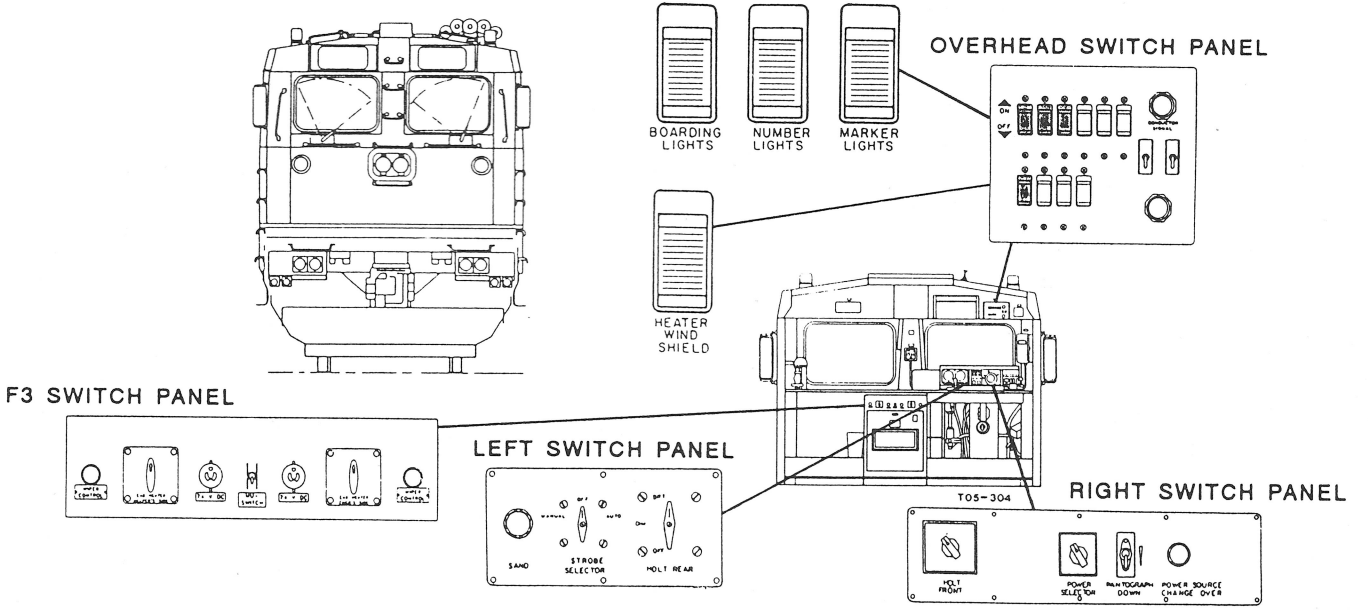

Figure 2-20. Exterior Lighting Controls

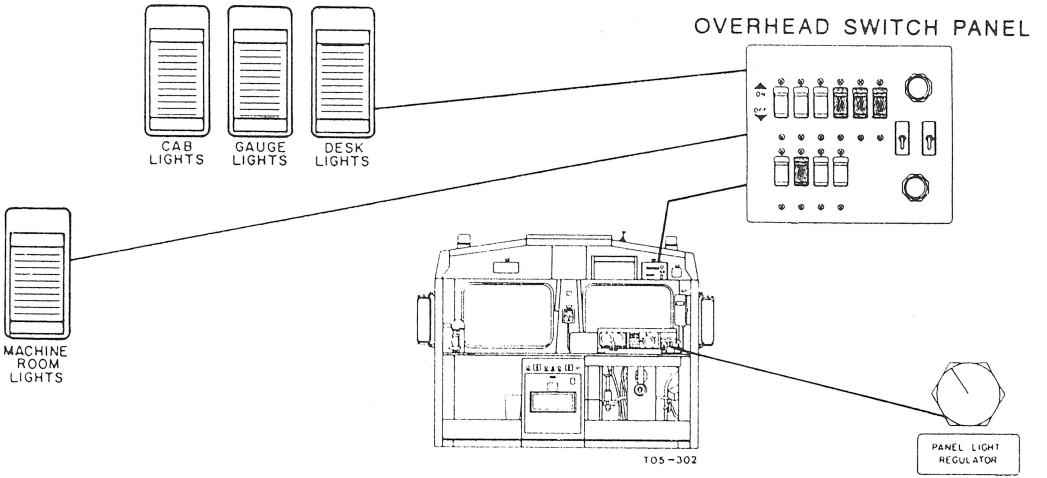

Figure 2-21. Interior Lighting Controls

ATC On/Off and Handbrake Applied Indicators

There are two ATC/Handbrake Applied Indicators behind the cab exterior doors on the exterior locomotive walls; one on the right side of the F end and another on the right side of the B end. Each has three indicators: Two white indicators are on when ATC is in effect; the bottom blue indicator lights when the handbrake has been applied.

Other Light Switches

Locomotive interior lighting is controlled from switches on the overhead switch panel. In addition, the light intensity of the panel lights can be regulated from the Panel Light Regulator located on the desk (Figure 2-21). The desk light switch controls the ceiling-mounted engineer's desk light. The boarding light switch controls the step lighting the engineer. The number light switch controls the locomotive identification lights at each locomotive end. Similarly, marker lights, cab lights, gauge lights, and machine room lights all operate when the switches are in the up position.

DOOR CONTROLS

The door bypass and no motion switches on the overhead switch panel allow the engineer to bypass automatic door control, if necessary (Figure 2-22). The No Motion switch allows the engineer to have control over the opening and closing of car doors to protect the passengers in the event of a station overrun. To keep all doors closed at a stop, the engineer presses the foot switch. (In such events, the conductor manually opens selected cars for passenger departure). The Door Bypass switch allows the engineer to operate the locomotive with the car doors open.

In order to enable the door controls when the locomotive is trailing, the marker light must be on.

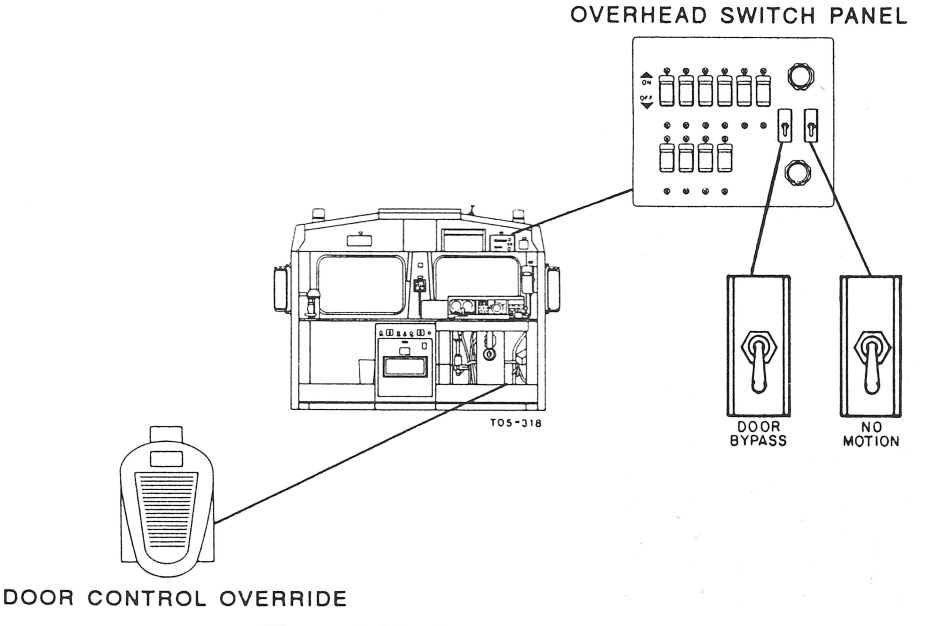

Figure 2-22. Door Operating System

MACHINE ROOM

The operating controls and indicators in the machine room are located on the S7 electrical cabinet, the Y2 electronic cabinet, and the Y3 HEP cabinet (Figure 2-23). The location and use of these controls and indicators are described below.

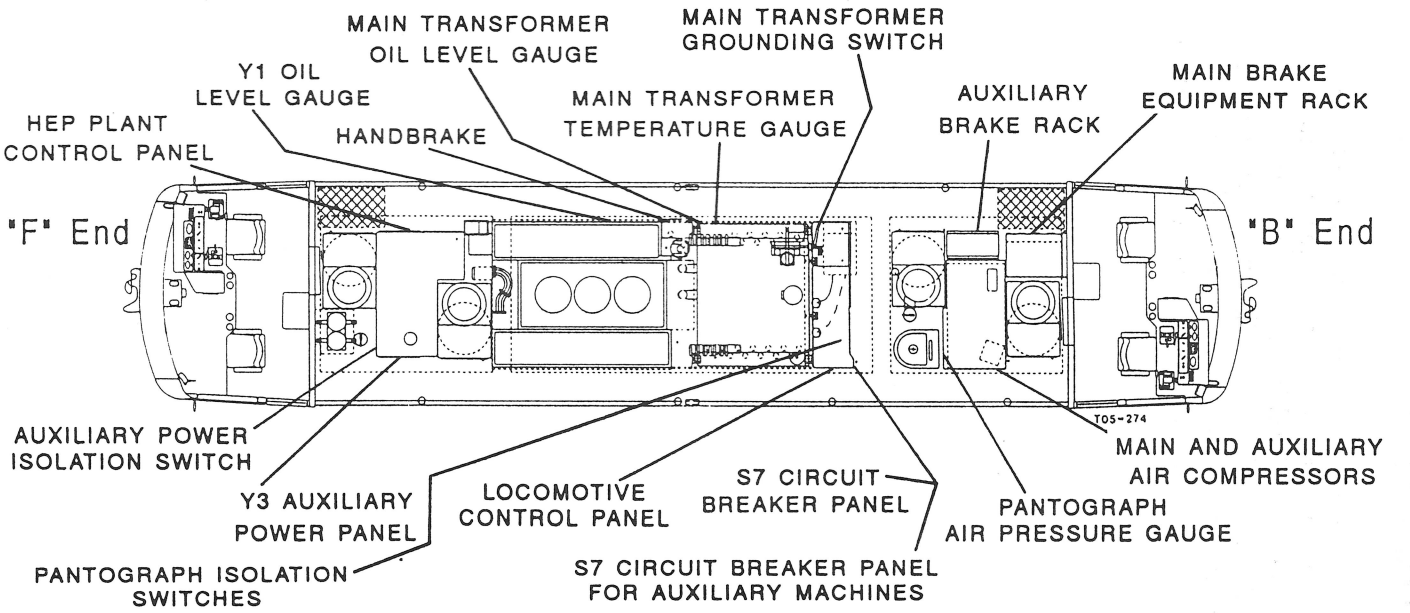

Figure 2-23. Machine Room Controls

S7 ELECTRICAL CABINET

The S7 electrical cabinet contains a circuit breaker panel, a circuit breaker panel for auxiliary machines, and a locomotive control panel (Figure 2-24).

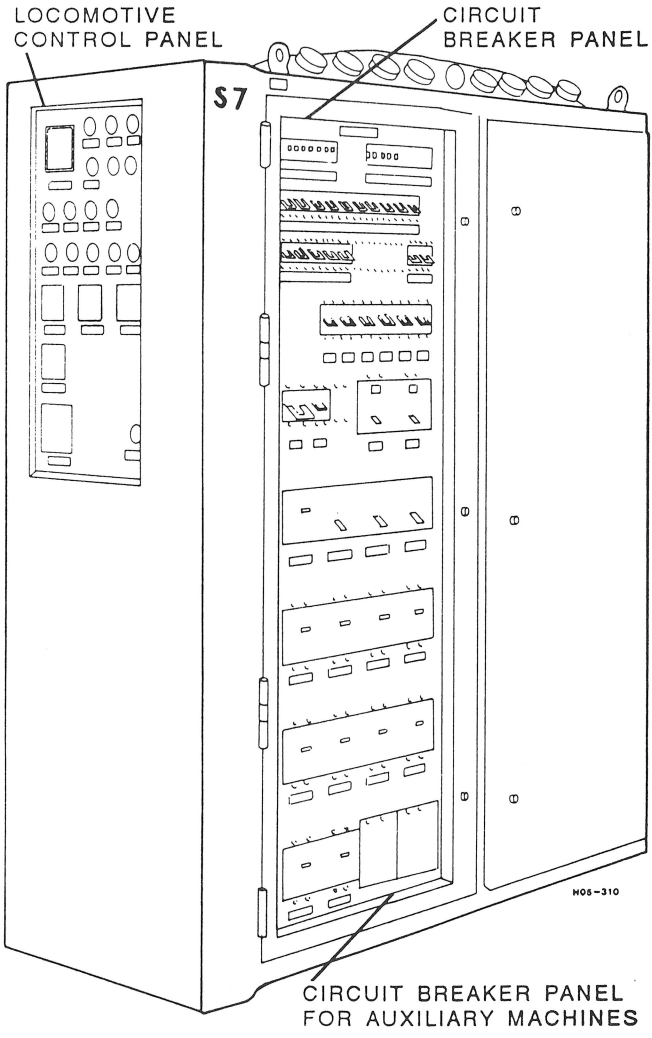

Figure 2-24. S7 Electrical Cabinet

S7 Circuit Breaker Panel

The S7 circuit breaker panel contains circuit breakers for the control and auxiliary circuits (Figure 2-25). Table 2-3 lists and describes them, beginning with the top row of circuit breakers.

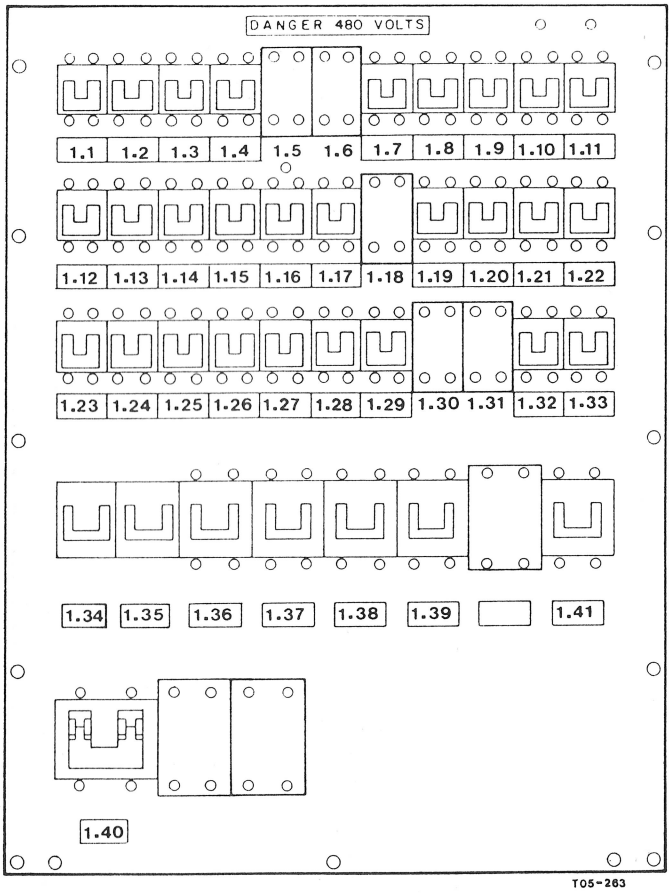

Figure 2-25. S7 Circuit Breaker

Table 2-3. S7 Circuit Breaker Panel

POSITION	CB	PROTECTS
1.1, 1.2, 1.3, 1.4	CAB HEATER BLOWER	Four cab heater blower circuits (A separate cab heater blower is provided for the engineer and the helper in each cab, four total.)
1.5, 1.6		Unused
1.7	AIR DRYER HEATER	Air dryer heater circuit of the compressed air system
1.8	HEADLIGHTS	Front headlight circuits
1.9	HEADLIGHTS	Rear headlight circuits
1.10	STROBE LIGHTS	Front/Rear strobe light circuits
1.11	ALERTER SP. IND.-REC.	Speed indicator/recorder circuit
1.12	AUXILIARY AIR COMPRESSOR	Auxiliary air compressor circuit (The 74 VDC system powers the auxiliary compressor to raise the pantograph and close the main circuit breaker).
1.13	LIGHTNING ARRESTOR DISCONNECT MOTOR	Lightning arrestor disconnect motor circuit (Two roof mounted lightning arrestors)
1.14	TAP CHANGER MOTOR	Tap changer motor circuit
1.15	VC/PB CONTROL	Voltage changeover/phase break control circuit
1.16	ATC/CAB SIGNAL	Automatic train control/cab signal control circuits (sealed circuit)
1.17	RADIO	Front/Rear cab radio communication system circuits

Table 2-3. S7 Circuit Breaker Panel (cont'd)

POSITION	CB	PROTECTS
1.18	Unused	
1.19	BATTERY PROTECTOR	Battery protection circuit and battery protector tripped indicator light circuit
1.20	AUTOMATIC BLOW DOWN TIMER	Compressed air system automatic drain valve timer circuit
1.21	WATER COOLER	Water cooler circuit
1.22	CATENARY VOLTAGE	Line voltage meters in the cab and isolation transformer for the VC/PB
1.23	ELECTRONICS	Direct current power supply circuits, controlling main propulsion and auxiliary power converters
1.24	CONTROL	13T control circuit
1.25	LOCAL CONTROL 1	Locomotive positive (PA) and negative (NA) local control circuits
1.26	LOCAL CONTROL 2	Locomotive positive (PA) and negative (NA) local control circuits
1.27	LOCAL CONTROL 3	Locomotive positive (PA) and negative (NA) local control circuits

Table 2-3. S7 Circuit Breaker Panel (cont'd)

POSITION	CB	PROTECTS
1.28	LIGHTS	Circuits in both cabs for lights: Front/rear cab, desk, gauge, number, marker, and boarding. Also protects circuits to 74 VDC cab & machine room receptacle & machine room lights.
1.29	HEP CONTROL	74 VDC circuits control HEP converter operation. (The output voltages of two auxiliary secondary windings from the main transformer are applied to the HEP converter in order to provide 3 phase, 480 V, 60 Hz power to the cars.)
1.30, 1.31	AIR CONDITIONING	A/C control breakers
1.32	INTERNAL BLOWER	Y2 internal cooling blower
1.33	115 VAC OUTLET	The circuit to the 115 VAC receptacle located on the S7 locomotive control panel.
1.34, 1.35, 1.36, 1.37	CAB HEATER	Four cab heater circuits (A separate cab heater, each with a circuit and circuit breaker, is provided for the engineer and the helper in each cab.)
1.38, 1.39	WINDSHIELD HEATER	Windshield heater circuits, for each cab

Table 2-3. S7 Circuit Breaker Panel (cont'd)

POSITION	CB	PROTECTS
1.40	BATTERY CHARGER	Battery charger circuits (125A, 125 VAC)
1.41	ELECTRONICS	Direct current power supply circuits, controlling main propulsion and auxiliary power converters, 5A, 240VAC supply to the control circuits. The output of one main transformer secondary winding is transformed to a lower voltage by the auxiliary transformer which is applied to the converter control circuits. The electronics circuit breaker protects the alternating current supply to the control circuits.

S7 CIRCUIT BREAKERS FOR AUXILIARY MACHINES

Circuit breakers for auxiliary machines are provided on the S7 circuit breaker panel for auxiliary machines (Figure 2-26).

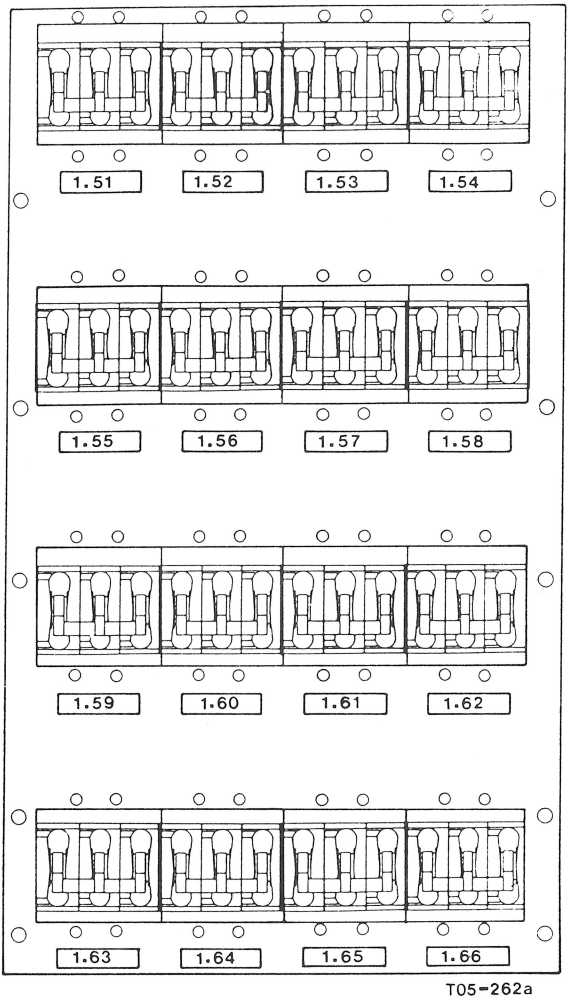

Figure 2-26. Circuit Breakers for Auxiliary Machines

Table 2-4. S7 Circuit Breakers for Auxiliary Machines

POSITION	CB	PROTECTS
1.51	Traction motor blower 1 upper	15A, 480VAC, 60 Hz supply to the upper portion of traction motor blower 1.
1.52	Traction motor blower 1 lower	15A, 480VAC, 60 Hz supply to the lower portion of traction motor blower 1.
1.53	Converter radiator blower 1	15A, 480VAC
1.54	Converter internal blower	15A, 480VAC
1.55	Traction motor blower 2 upper	15A, 480VAC
1.56	Traction motor blower 2 lower	15A, 480VAC, 60 Hz supply to the lower portion of traction motor blower 2.
1.57	Converter radiator blower 2	15A, 480VAC
1.58	Blower	9A, 480VAC, supply to the air compressor radiator blower.
1.59	Traction motor blower 3 upper	15A, 480VAC
1.60	Traction motor blower 3 lower	15A, 480VAC
1.61	Converter radiator blower 3	15A, 480VAC, 60 Hz supply to the converter radiator blower 3.
1.62	External blower compressor	2.5A, 480VAC

Table 2-4. S7 Circuit Breakers for Auxiliary Machines (cont'd)

POSITION	CB	PROTECTS
1.63	Traction motor blower 4 upper	15A, 480 VAC
1.64	Traction motor blower 4 lower	15A, 480 VAC, 60 Hz supply to the lower of the traction motor blower 4.
1.65	External blower S7 and Y2	2.5A, 480VAC, 60Hz supply to the external blower S7 and Y2.
1.66	External blower Y3 and Y1	2.5A, 480VAC, 60 Hz supply to the external blower Y3 and Y1.

These circuit breakers control all blower motors and the machine room fan motor. Each circuit breaker contains a hydraulic magnet overload sensing device which automatically disconnects the motor from its power source if the motor becomes overloaded.

The circuit breakers have a manually operated handle for resetting the protection device. You can use the switch to:

- Start the motor
- Reset the protection device
- Open the feed to the motor (switch in OFF position)

There is a circuit breaker for:

- Each of the three converter radiator blower motors
- Each of the four upper and four lower traction motor blower motors
- The machine room fan motor
- Thyristor converter internal blower

The following table shows the results of various overload conditions.

NOTE: Moving the applicable circuit breaker handle to the on position resets the protection device.

Table 2-5. Circuit Breaker Overload Conditions

CB TRIPPED	RESULT
Any thermal overload	BLOWER STOPPED indicating light on the circuit breaker fault and indicating light panel, located in the cab, turns on.
Any one of the traction motor blowers	Propulsion, HEP, auxiliary power systems shut down.
All three converter radiator blower motors	Propulsion, HEP, Auxiliary power systems shut down.
External blower compressor	Operation may continue until high temperature shuts down locomotive.
Main air compressor radiator blower motor	Operation may continue until high temperature shuts down locomotive.
One or two thyristor converter radiator blower motors	Operation may continue until high temperature shuts down locomotive.

Circuit breakers are provided inside the S7 electrical cabinet for the transformer cooling oil pump motor, the converter cooling oil pump motor, and the main air compressor drive motor. Table 2-6 explains how thermal overloads affect the system.

Table 2-6. Effect of Thermal Overloads

Thermal Overload On	Results In
Transformer cooling oil pump motor	Immediate shutdown of the Propulsion, HEP, and auxiliary power systems.
Converter cooling oil pump motor	Immediate shutdown of the propulsion, HEP, and auxiliary power systems.
Main air compressor drive motor	Operation may continue until system air pressure decreases below a specific value, at which time the main circuit breaker opens.

NOTE: The thermal overload device on these starters resets automatically when temperature falls below the trip point.

S7 LOCOMOTIVE CONTROL PANEL

A battery charge meter, a 115 VAC receptacle, and various switches are located on the S7 locomotive control panel (Figure 2-27). Table 2-7 lists the indicators or switches and descriptions.

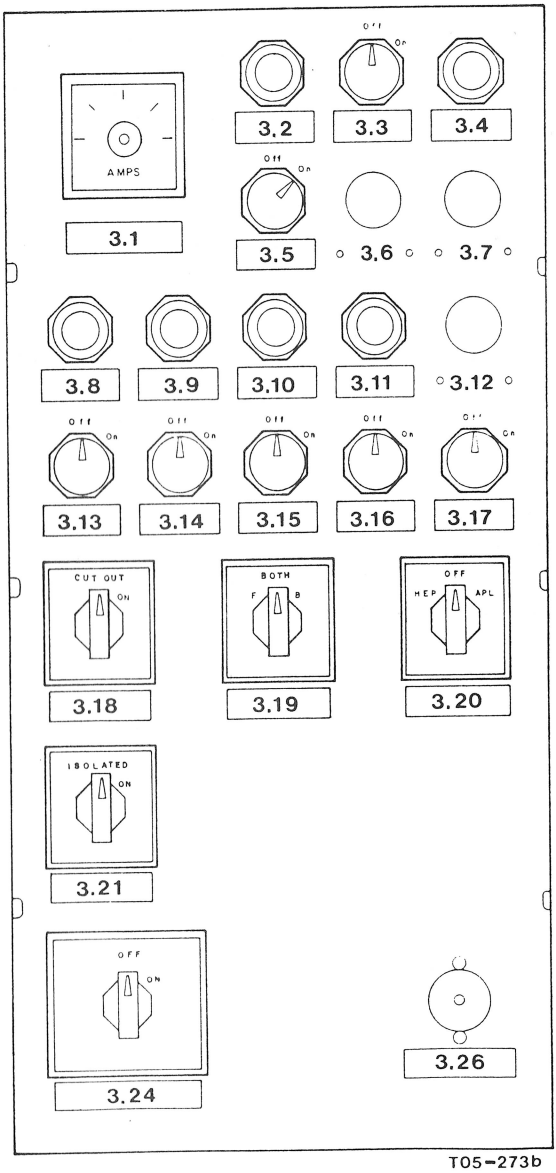

Figure 2-27. S7 Locomotive Control Panel

Table 2-7. S7 Locomotive Control

POSITION	INDICATOR/ SWITCH	FUNCTION
3.1	Battery Charge Meter	A zero center ammeter. During normal operation with fully charged battery, indicator is in green zone. Indicator in red zone indicates battery is discharged.
3.2	Battery Protector Trip	Press-To-Test Pushbutton Indicator
3.3	Battery Protector Override Switch	If battery voltage falls below 55 VDC with battery charger inoperative, battery protector contactor drops out, disconnecting battery.
3.4	Battery Protector Reset Pushbutton	Provides a means to reset the battery protector after the battery has been recharged.
3.5	VC/PB AUTO: Automatic Voltage Changeover /Phase Break	Provides manual backup for VC/PB operation.
3.6, 7		Unused
3.8	Propulsion Reset Pushbutton	Resets propulsion breaker in blower cabinets.
3.9	Auxiliary Air Compressor Pushbutton	Energizes system so auxiliary air compressor builds pressure for raising pantograph and closing the main circuit breaker.

Table 2-7. S7 Locomotive Control (cont'd)

POSITION	INDICATOR/ SWITCH	FUNCTION
3.10, 3-11	Wheel Slide Protection Test Pushbutton, Front and Rear Truck	For testing wheel slide protection system.
3.12		Unused
3.13, 3-14, 3-15, 3-16	Traction Motor Cut Out Switches	All four set to the on position for normal operation. If a fault develops, affected motor can be cut out or isolated.
3.17	Dynamic Brake Cut Out Switch	Allows dynamic brake system to be cut out in case it develops trouble. OFF prevents transfer to dynamic braking; ON is for normal operation.
3.18	Ground Relay Cut Out Switch	For test and maintenance operations. The switch must be set to the on position to operate the locomotive.
3.19	Pantograph Selector Switch	For selecting front, rear, or both.
3.20	Auxiliary Power Source Selector	Set to APL so power for auxiliary equipment comes from power converter. If a fault develops in the auxiliary power converter, set selector to HEP to obtain auxiliary power from the HEP converter, or the HEP trainline.

Table 2-7. S7 Locomotive Control (cont'd)

POSITION	INDICATOR/ SWITCH	FUNCTION
3.21	Propulsion Isolator Switch	Must be on during power and dynamic brake operation. The ISOLATED position prevents pickup of any power or dynamic brake contactors and disables the propulsion systems. Does not affect HEP system.
3.24	Battery Switch	Set to the on position during normal operation. OFF disconnects the battery during servicing or to prevent battery discharge when the unit is standing with no catenary power applied.
3.26	Receptacle 115 VAC outlet	

WARNING: When operating pantograph selector switch, do not set it to the BOTH position with both isolation switches closed. This action enables raising and energizing of both pantographs without opening the main circuit breaker. Do not operate the locomotive in this condition or serious damage may occur.

Notes to Table 2-7

Numbers reference the indicator/switch in Table 2-7.

(3.2) When the system disconnects the battery, the BATTERY PROTECTOR TRIP PRESS-TO-TEST pushbutton indicator lights up as does the BATTERY PROTECTOR TRIPPED light on the fault and indicator panel.

(3.2) If the battery protector trips while the reverser is in F, N, or R position and the battery switch is closed, the main circuit breaker opens. All locomotive circuits lose energy except for the radio, train communication, ATC/Cab Signal system, and strobe lights.

(3.2) If the reverser is in the I position or the battery switch is open, the main circuit breaker opens, all circuits lose energy, and the pantograph comes down.

(3.8) The FAULT RESET pushbutton is on the overhead switch panel. PROPULSION RESET pushbuttons are located on the top left side of the rear cab wall and on the S7 electrical cabinet in the machine room.

(3.10/3.11) When either button is pressed, a wheel slide condition is simulated. The Wheel Slip indicator light turns on and the air brakes should immediately release, then reapply about four seconds later.

(3.10/3.11) During blended brake or air brake operation, the deceleration rates of all four axles are monitored. If any axle is slowing down too rapidly, indicating a sliding wheel set, brake cylinder pressure is reduced immediately. Once the sliding condition is eliminated, cylinder pressure returns to the previous level.

(3.10/3.11) If the wheel slide indication is present for an extended period of time, brake cylinder pressure will return to the previous level after four seconds.

(3.20) If a locomotive has an auxiliary power convertor fault, it can use its HEP convertor for auxiliary power, or, during MU operation, the other locomotive can supply power via the HEP trainline. See HEP ISOLATION SWITCH later in this section.

Y2 ELECTRONIC CABINET

A diagnostic voltmeter and two voltmeter signal selectors are installed at one end of the Y2 electronic cabinet (Figure 2-28).

Diagnostic Voltmeter

The diagnostic voltmeter facilitates troubleshooting of the locomotive control circuits. It allows you to select the appropriate signals to measure control voltages.

For more accurate signal measurement and recordings, test jacks are provided below the diagnostic voltmeter for connection of an external digital voltmeter.

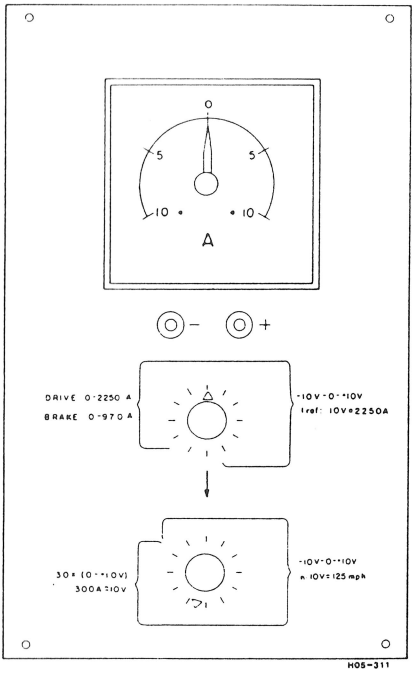

Figure 2-28. Y2 Electronic Panel

Y3 HEP CONTROL CABINET

The Y3 HEP Control Cabinet, located in the machine room near the F-End, has two control and indicator panels. HEP system controls and indicators are located on the HEP Plant Control Panel (Figure 2-29).

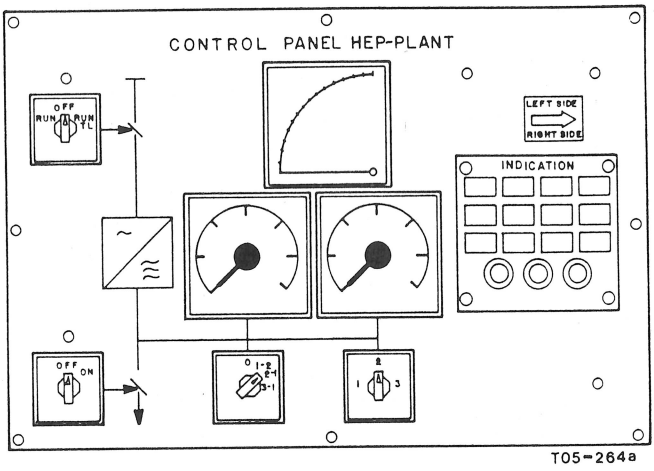

Figure 2-29. Y3 HEP Plant Control Panel

HEP PLANT CONTROL PANEL

Table 2-8 describes the controls and indicators on the HEP Plant Control Panel.

Table 2-8. INDICATING LIGHTS AND PUSHBUTTONS

Indicator/ Control	Function
HEP OUT CONTACTOR CLOSED	ON when HEP output circuit breaker is closed.
HEP OUT CONTACTOR OPEN	ON when the HEP output circuit breaker is opened, either by the HEP switch or by HEP converter fault. This does not affect locomotive operation, but HEP is not available to the cars. HEP operation may be rstored by reducing the load on the HEP converter.
HEP ISOL CONTACTOR CLOSED	ON when single phase AC power is applied to the HEP converter.
HEP TR. LINE EXT. FEED	ON when the three phase 480 VAC trainline HEP is being provided by some source other than the HEP converter.
TLC LEFT SIDE	ON when left side HEP trainline connections are complete and either HEP isolation switch is set to RUN TL position, or HEP trainline test pushbutton is pressed.
TLC RIGHT SIDE	ON when right side HEP trainline connections are complete and either the HEP isolation switch is set to RUN TL position, or the HEP trainline test pushbutton is pressed.
HEP GROUND	ON when a ground is detected in the HEP system. Correct this condition as soon as practical. If necessary, HEP operation may continue with one phase grounded.

Table 2-8. INDICATING LIGHTS AND PUSHBUTTONS (cont'd)

Indicator/ Control	Function
HEP SECONDARY OVERLOAD	ON when an overload exists on the main transformer secondary windings to the HEP system.
HEP ONE FUSE BLOWN	ON when one fuse of the DC link in the HEP system is open. (Correct as soon as practical. If necessary, HEP operation may continue.)
HEP FUSES BLOWN	ON when one of the AC input fuses or at least two DC link fuses in the HEP system are open, tripping the main circuit breaker. Locomotive operation may continue by isolating the HEP system, but HEP is not provided to the cars.
HEP VOLT Hz	ON when the HEP voltage or frequency has failed to meet required specifications for more than five seconds, opening the HEP output circuit breaker. This does not affect locomotive operation, but HEP is not available to the cars.
HEP CONVERTER FAULT	ON when a HEP converter fault occurs, tripping the main circuit breaker. Locomotive operation may continue by isolating the HEP system, but HEP is not provided to the cars.
HEP TRAINLINE TEST PUSH BUTTON	For checking continuity of the HEP trainline connections prior to placing the HEP isolation switch in the RUN TL position. To use, set the HEP isolation switch to OFF position. Then, press and hold the TLC TEST pushbutton. If there is continuity in the HEP trainline, the TLC LEFT SIDE and TLC RIGHT SIDE indicating lights will be lit.

WHITE AMBER GREEN RED

Table 2-8. INDICATING LIGHTS AND PUSHBUTTONS (cont'd)

Indicator/ Control	Function
HEP INDICATOR LIGHTS TEST PUSH BUTTON	For checking HEP indicator lights. All HEP indicating lights should turn on when the pushbutton is pressed.
HEP RESET PUSH BUTTON	Resets the fault detection circuits for the HEP system.
HEP ON/OFF SWITCH	The HEP output breaker cannot close until this switch is set to ON position. This switch must be OFF when the HEP isolation switch is in the RUN position.
HEP VOLTMETER AND VOLTMETER SELECTOR	Has four positions 0, 1-2, 2-3, and 3-1. When set to 0, the HEP voltmeter is disconnected from the HEP output. Positions 1-2, 2-3, and 3-1 are for connecting the HEP voltmeter to the three different phases of the HEP output.
HEP AMMETER AND AMMETER SELECTOR	Has positions 1, 2, and 3 to connect the HEP ammeter to phase 1, 2, or 3 of the HEP output.
HEP FREQUENCY METER	A 56 to 64 Hz frequency meter connected through the HEP voltmeter circuit breaker to phase 1-2 of the 60 Hz HEP output.
HEP VOLTMETER CIRCUIT BREAKER	Protects the HEP voltmeter and frequency meter circuits. To operate: open the right door near the HEP control and indicator panel and observe the 3-pole circuit breaker on the left partition near the front of the compartment. When closed, circuit breaker is in the up position.

Table 2-8. INDICATING LIGHTS AND PUSHBUTTONS (cont'd)

Indicator/ Control	Function
AUXILIARY POWER VOLTMETER CIRCUIT BREAKER	Located on the opposite side of the HEP converter compartment from the HEP voltmeter circuit breaker.
LEFT SIDE RIGHT SIDE ARROW	Lights which turn on when HEP trainline continuity has been attained. The TLC RIGHT SIDE and TLC LEFT SIDE indicating lights refer to the right and left sides of the locomotive and not the train.

HEP Fault Reset Pushbutton

The FAULT RESET pushbutton is located on the overhead switch panel above the engineer's desk. The HEP reset pushbuttons are located at the top left side of the rear cab wall and on the HEP control panel.

Although the propulsion and head end power fault pushbuttons on the cab rear wall duplicate the reset functions in the machine room (S7, Y3), you should, when necessary, leave the cab area to make the appropriate fault inspections.

Any HEP converter fault may be reset one time by pressing the FAULT RESET pushbutton on the overhead switch panel in the cab. If the fault occurs a second time, reset the fault by pressing the fault reset pushbutton on the top left side of the rear cab wall and on the HEP control panel.

NOTE: You can reset the fault detection circuits more than one time. Follow applicable railroad instructions when doing so.

HEP Isolation Switch

The RUN TL position provides normal operation for the locomotive's HEP converter which, in turn, supplies power on the HEP trainline to the passenger cars. When two locomotives are working together, the RUN position enables the HEP converter to supply power to the locomotive's auxiliary machines while the other locomotive's HEP converter supplies power on the HEP trainline to the passenger cars.

When HEP converter operation is not required, such as during MU operation or during a long wait prior to coupling to the train, the HEP converter may be shut

down by setting the switch to OFF. This momentarily opens the main circuit breaker and shuts down the HEP converter.

If a failure occurs in the auxiliary power converter of an ALP-44 locomotive operating by itself, then the HEP converter can supply power for the auxiliary machines and to the HEP trainline for the passenger cars. This requires that the auxiliary power selector switch (see fig. 2-27) is in the HEP position. The HEP isolation switch must be set to the RUN TL position to provide control power to the HEP trainline complete safety circuit. (The HEP trainline complete lights should go on). The RUN TL position allows continued locomotive operation with an auxiliary power converter fault but with a reduced HEP capability for the passenger cars and the possibility of overloading the HEP converter.

If a failure occurs in the auxiliary power converter of an ALP-44 locomotive in multiple unit operation, then one locomotive can supply full HEP to the passenger cars while the faulted locomotive uses its HEP converter to power its own auxiliary load. This requires that the auxiliary power selector switch (see fig. 2-27) in the faulted locomotive be in the HEP position. The HEP isolation switch on the faulted locomotive must be set to the RUN position. This allows the HEP converter to power the auxiliary load without interrupting the HEP trainline complete safety circuit established by the other locomotive that is supplying headend power to the passenger cars.

NOTE: The HEP On/Off switch controls the HEP convertor connection to the HEP trainline. While operating with the HEP isolation switch in the RUN position the HEP On/Off switch in the faulted locomotive must be set to OFF.

NOTE: In order to get supply to the battery charger when a failure occurs in the auxiliary converter, the Dead Engine Switch must be in the DEAD position. This switch is also referred to as the Locomotive Switch and is located on the side of Y3 facing the auxiliary transformer.

Arrow Indicator Considerations

When connecting the HEP trainline jumpers from the train to the locomotive, the TLC RIGHT SIDE and TLC LEFT SIDE lights turn on to indicate when HEP trainline continuity has been attained. The TLC RIGHT SIDE and TLC LEFT SIDE indicating lights refer to the right and left sides of the locomotive and not the train. Since the train may be coupled to the locomotive at either end, the LEFT SIDE - RIGHT SIDE indicating arrow has been provided to assist in determining which side of the train to inspect if one side of the HEP trainline is not complete.

To determine the side of the train with the incomplete HEP trainline, stand facing the direction in which the arrow is pointing. In this position the TLC RIGHT SIDE and TLC LEFT SIDE indicating lights determine the side of the locomotive with the incomplete HEP trainline. The corresponding side of the train should be checked for a HEP trainline fault.

AUXILIARY POWER CONTROL PANEL

The auxiliary power controls and indicator panel are located on the Y3 Auxiliary Power Control panel (Figure 2-30).

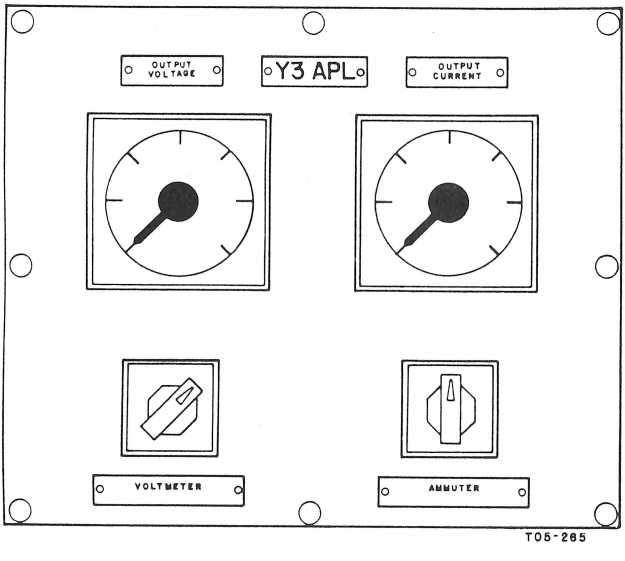

Figure 2-30. Y3 APL Control Panel

Auxiliary Power Output Voltmeter and Voltmeter Selector

This selector has four positions 0, 1-2, 2-3, and 3-1. When set to 0 position, the auxiliary power voltmeter is disconnected from the auxiliary power system output. Positions 1-2, 2-3, and 3-1 are provided to connect the auxiliary power voltmeter to the three phases of the auxiliary power system output.

Auxiliary Power Output Ammeter and Ammeter Selector

This selector has positions L1, L2, and L3 to connect the auxiliary power system ammeter to phase 1, 2, or 3 of the auxiliary power system output.

Air Conditioner Transformer Circuit Breaker

A 15A circuit breaker protects the cab air conditioner transformer. It is inside the Y3 cabinet, on the right HEP side, at the bottom.

AIR BRAKE EQUIPMENT RACK

The air brake equipment rack is located in the machine room at the "B" cab end (Figure 2-31). The rack contains certain manual controls which are not normally positioned by the engineer. However, under certain operating conditions or equipment failure, the controls may have to be repositioned to allow continued operation. The following descriptions are for information only; refer to specific railroad operating rules and air brake instructions before repositioning any of the following controls.

Dead Engine Cutout Cock

The dead engine cutout cock has two positions, OUT and IN. During normal operation, the handle is in the OUT position. If the locomotive is to be shipped dead in a train with no main reservoir pressure available from another locomotive, the handle must be positioned to the IN position.

Train Control Cutout Cock

The train control cutout cock has two positions, OUT and IN. During normal operation, the handle is sealed in the IN position. When the handle is moved to the OUT position, the train control system is cut out of the air brake system.

Safety Control Cutout Cock

The safety control cutout cock has two positions, OUT and IN. During normal operation, the handle is sealed in the IN position. When the handle is moved to the OUT position, the alerter control system is cut out of the air brake system.

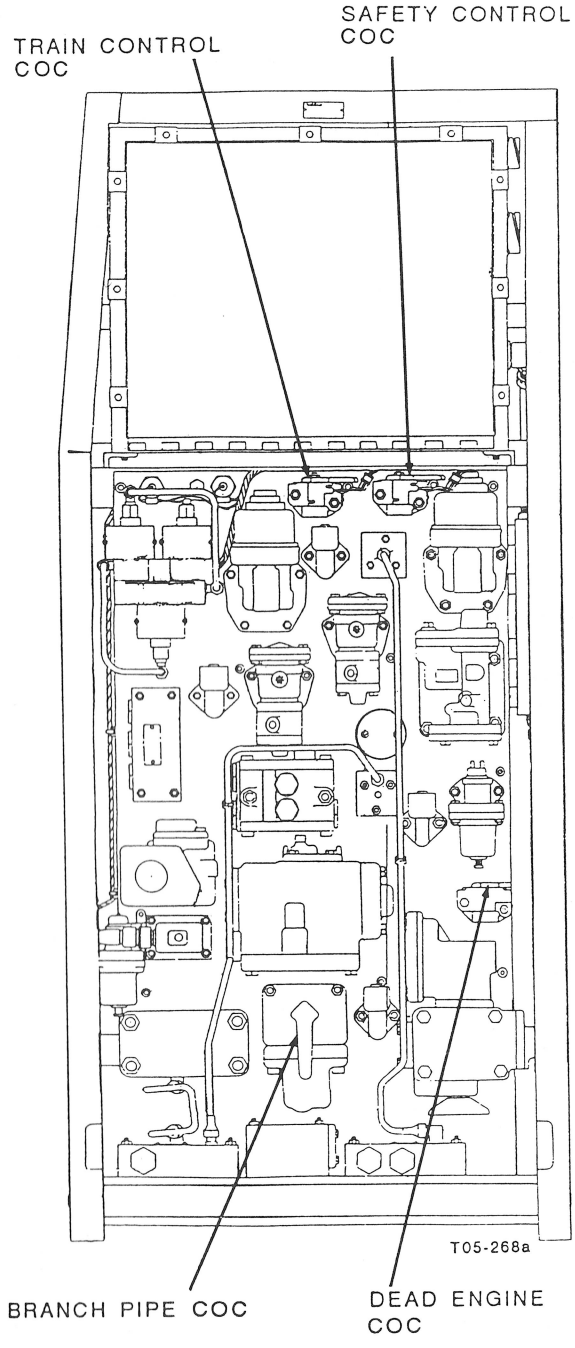

Figure 2-31. Air Brake Equipment Rack

26F Control Valve Release Cap

The service portion of the 26F control valve contains a release cap (not shown) which may be positioned to allow either graduated or direct release of the locomotive air brake. Set as follows:

- GRA - Passenger Service not using CS-2 system
- DIR - NJDOT passenger service using CS-2 system (Push-Pull Service)
- DIR - Freight train service
- DIR - Moving Dead-In-Train

Branch Pipe Cutout Cock

The branch pipe cutout cock has two positions, OUT and IN. During normal operation the handle is in the IN position. When the handle is in the OUT position, braking effort is nullified during brake applications using the automatic brake valve. However, braking effort is still attainable when a brake application is called for by the independent brake valve.

AUXILIARY BRAKE RACK

This rack controls the N-3-E magnetic valve. This valve is normally sealed open. If necessary, this valve can be closed to isolate the emergency brake magnet valve (Figure 2-32).

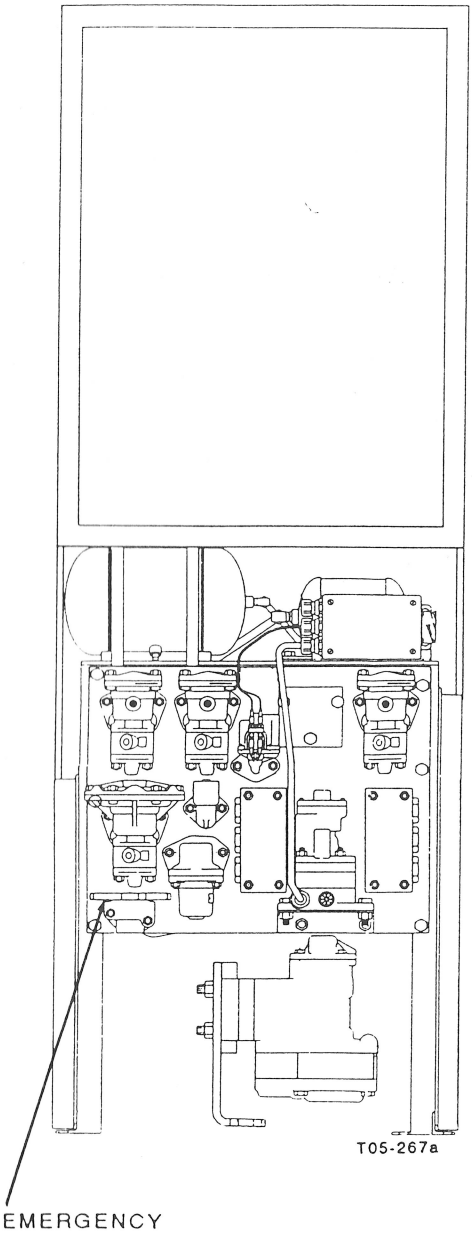

Figure 2-32. Auxiliary Brake Rack

AIR SUPPLY

Enclosed in a cabinet behind the B-End cab, the main air compressor provides compressed air for the locomotive after the main circuit breaker closes (Figure 2-33). The oil gauges (sight glass) and airline pressure gauge are located to the lower left. If the main reservoir pressure is less than 100 psi on increasing pressure, the 74 VDC auxiliary air compressor supplies air for raising the pantograph and closing the main circuit breaker (Figure 2-34). If battery voltage is not sufficient to operate the auxiliary compressor, a 2500 cu.in. air supply reservoir located on the auxiliary air compressor rack provides sufficient pressure to raise the pantograph and close the main circuit breaker.

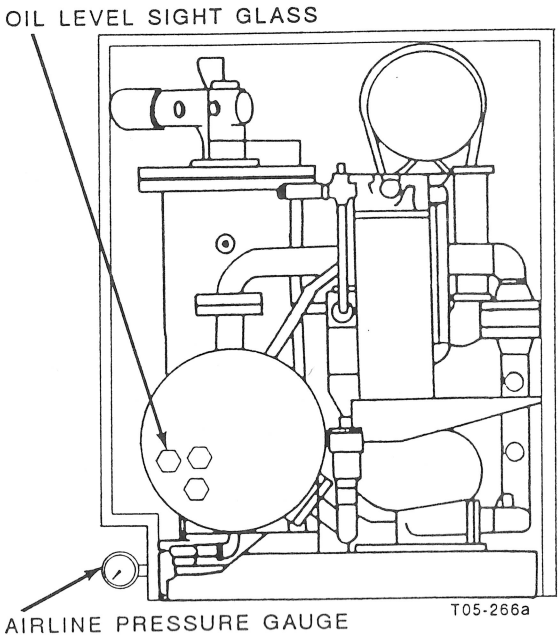

Figure 2-33. Main Air Compressor

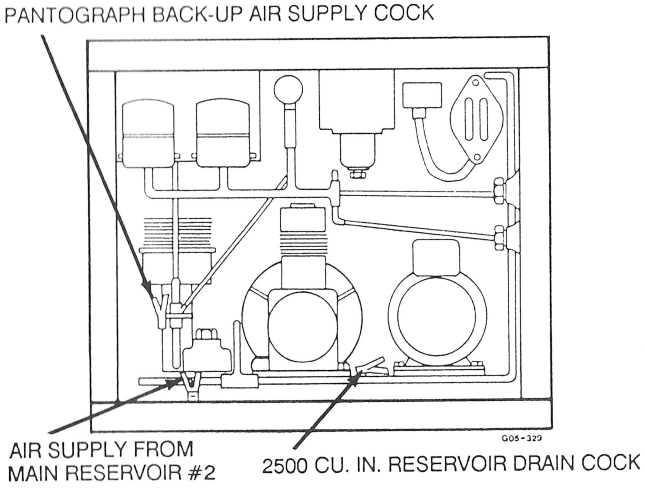

Figure 2-34. Auxiliary Air Compressor

MAIN TRANSFORMER GROUNDING SWITCH

WARNING: Do not operate the main transformer grounding switch unless both pantographs are lowered and locked down.

A switch is provided on the main transformer to ground the primary side when it is necessary to work on or near the main transformer. The switch must be in the open position in order to operate the locomotive. When the maintenance employee closes the switch (in order to ground the main transformer), the control circuits open to prevent the pantograph from rising or the main circuit breaker from closing.

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SECTION 3.
OPERATION

PREPARING THE LOCOMOTIVE

This section contains procedures for preparing the ALP-44 locomotive for operation. This includes inspecting the roof, underbody, equipment room, and both cabs, as well as setting up the locomotive for single or multiple unit operation.

INSPECTING THE ROOF AND UNDERBODY

1. Inspect for:
   - Air and oil leaks
   - Dragging, defective, or loose equipment under locomotive
   - Satisfactory condition of all tread brake shoes and brake disc pads
   - Satisfactory condition of the raised pantograph

WARNING: When unit is under a catenary, make roof inspections only from the ground.

2. Be sure:
   - Brake cylinder (Truck) cut out cocks of both trucks are cut in
   - Other air cut out cocks are in normal positions (main reservoir, auxiliary device cut out cocks, etc.)
   - Ground switch/hold down hooks of both pantographs are released
   - Two short HEP loop jumper cables are installed between adjacent receptacles at leading end of lead locomotive
3. Hand or air brakes are applied, then remove chocks or chains.

INSPECTING THE MACHINE ROOM

1. Check for air and oil leaks and be sure the following fluid levels are within the tolerances indicated on their respective labels or scales:
   - air compressor oil level (sight glass)
   - converter coolant level (Y1 cabinet)
   - transformer coolant level (gauge)

NOTE: There is also a transformer oil temperature scale for viewing once the locomotive is in operation. In addition, the oil compressor has three sight glasses positioned at different heights. Oil level is within tolerance when it is visible in the lower two sight glasses.

WARNING: If any fluids are below acceptable levels, do not operate the locomotive. Notify mechanical department.

2. Check the hoses and pipes for air and oil leaks.
3. All circuit breakers located on the S7 electrical cabinet are ON.

4. Set the S7 electrical cabinet switches as follows:

Automatic VC/PB Cutout Switch	On (Auto) Off (Manual)
Auxiliary Power Source Selector	APL
Battery Switch	ON
Battery Protector Override Switch	OFF
Dynamic Brake Cutout Switch	ON
Ground Relay Cutout Switch	ON
Pantograph Selector	As Required
Propulsion Isolator Switch	ON
Traction Motor Cutout Switches	ON

5. Set the Y3 HEP control cabinet switches as follows:

HEP Ammeter Selector	1, 2, or 3
HEP Isolation Switch	RUN TL
HEP ON/OFF Switch	OFF
HEP Voltmeter Selector	0

6. On the Y3 HEP control cabinet, press and hold the HEP light test switch (all twelve HEP lights come on).

SETTING UP NON-OPERATING CAB

A non-operating cab must have the air brake controls, throttle, reverser, and other switches set as described below. For pantograph settings, see "Operating Pantographs."

Setting Air Brake Controls for Non-Operating Cab

1. Make a Full Service application with the Automatic Brake Valve, and LAP the brake valve.
2. When brake pipe exhaust stops, place the Automatic Brake Valve Cut Off Pilot Valve to OUT.
3. Move the Automatic Brake Valve to Handle Off
4. Move the MU-2-A to TRAIL 24-26.
5. Move the Independent Brake Valve to Release

Setting Throttle and Reverser in Non-Operating Cab

1. Set throttle to 0
2. Set reverser to I.
3. Remove reverser handle and either take it to the operating cab or store it.

Other Non-Operating Cab Settings

1. Set EP-4 switch to OFF.
2. Set light and heater switches as desired.

SETTING UP THE OPERATING CAB

Set the air brake controls, throttle, reverser, and other switches as described below. To operate pantographs, see "Operating Pantographs."

Setting Air Brake Controls in Operating Cab

1. Move the Independent Brake Valve to the FULL Application.
2. Place the MU-2-A Valve to LEAD-DEAD.
3. Move the Automatic Brake Valve to RELEASE.
4. Place the Automatic Brake Valve Cut Off Pilot Valve to IN.

Setting Throttle and Reverser in Operating Cab

1. If necessary, install reverser handle.
2. Temporarily, leave reverser in I.
3. Temporarily, leave throttle in O.

Setting Other Controls In Operating Cab

1. To check for the correct ATC operating setup on the ADU, move reverser to F, N, or R.
2. Place the light and heater switches in the desired positions.
3. Set MU switch in the F3 cabinet in the down position (OFF).
4. Set the EP-4 switch to ON.

PREPARING CAB FOR PUSH OPERATION

1. Leave the MU-2-A valve in LEAD-DEAD position.
2. Be sure the Independent Brake Handle is in Release.
3. Set the 13T CAB SWITCH, as follows:

   a. Push the 13T CAB switch to ON

   b. Turn the Marker light switch to ON

   c. Place the reverser handles in both ALP-44 cabs to I (Isolate)

NOTE: These steps provide +74 VDC voltage to the cab for control power.

4. Remove the reverser handles in I (Isolate).

NOTE: To configure the pantographs for this operation, follow NJT Operating Rules and heed all warnings regarding the raising and lowering of pantographs and the setting of related switches.

OPERATING PANTOGRAPHS

During normal operating conditions, the isolation switches to both pantographs are sealed closed. The trailing pantograph is raised and receiving current. Current passes through the closed isolation switch and on to the main circuit breaker. The leading pantograph is in the down position.

WARNING: To avoid serious injury, do not operate a pantograph or isolation switch unless all of the following conditions are met:

- **A visual check confirms that both pantographs are down**
- **All concerned personnel know that both pantographs are down**
- **One Pantograph Down switch is in the down position**
- **Catenary contact wire is at least *five feet* above the lowered pantograph**
- **Lockdown and grounding switches are not engaged**

In addition, be sure to follow all NJTRO operating procedures when working with pantographs and other high voltage equipment.

Lowering Pantographs

1. From either cab, move the Pantograph Down switch to the down position.
2. From the ground, visually inspect the pantographs from outside the locomotive to confirm that both of them are down. Observe all safety precautions.

CAUTION: Do not operate pantograph isolation switches unless both pantographs are lowered. Moving either isolation switch with either pantograph raised will damage the high voltage switch gear.

Raising Pantographs

1. To prepare to raise the F end pantograph only, set the S7 Pantograph Selection switch to the F position.
2. To prepare to raise the B end only, set the S7 Pantograph Selection switch to the B position.
3. To prepare to raise both pantographs, set the S7 Pantograph Selection switch to BOTH.
4. Be sure both pantographs are lowered and that neither ground switch/hold down hook is engaging either pantograph.

NOTE: At this time, both isolation switches are still sealed closed.

5. Check that the pantograph selection switch is set correctly.
6. Be sure the Pantograph Down switches in both cabs are in the up position. (Leaving either switch in the down position disables the PAN UP switch.)
7. Momentarily set the PAN UP switch on the Overhead Switch panel to the UP position and listen for the raising pantograph.
8. If the pantograph does not go up, check that the Pantograph Down switches are in the UP position in both cabs. If they are, there may be insufficient air pressure in the pantograph air line. To check the air pressure, see the air pressure gauge directly over the toilet in the equipment room. If it indicates less than 85 psi, press the auxiliary air compressor pushbutton on the S7 electrical cabinet. The auxiliary air compressor will charge the main circuit breaker/pantograph air system to 100 psi. Also, check NJTRO operating procedures for additional information.

SCRAPING SLEET FROM THE CATENARY

During sleet scraping operations, the trailing pantograph is raised and collecting current. The lead pantograph, with isolation switch moved to the OFF position, is raised to scrape sleet from the catenary. To prepare for sleet scraping:

1. Be sure both pantographs are lowered and that neither ground switch/hold down hook is engaging either pantograph.
2. Determine which end of the locomotive will have the leading pantograph.
3. Following NJTRO safety precautions, set the isolation switch (above the S7 cabinet) for the leading pantograph to the OFF position. In Figure 3-1, for example, the F-end is assumed to be the leading end.

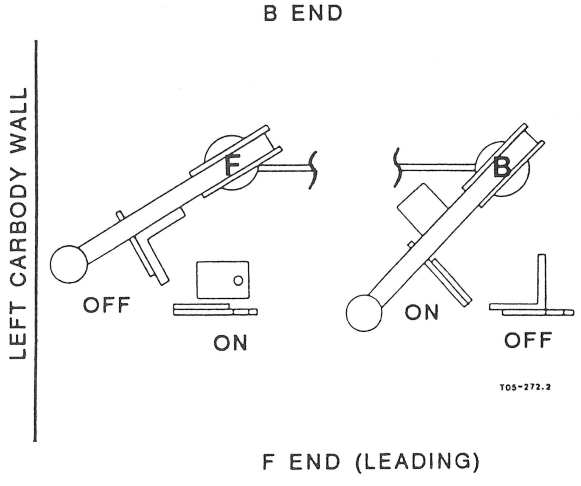

Figure 3-1. Sample Pantograph Isolation Switch Setting

4. Prepare to raise both pantographs by setting the S7 Pantograph Selection switch to BOTH.
5. Be sure the Pantograph Down switches in both cabs are in the up position. (Leaving either switch in the down position disables the PAN UP switch.)
6. Momentarily set the PAN UP switch on the Overhead Switch panel to the UP position and listen for the raising pantographs.
7. From the ground, visually check that both pantographs have engaged the catenary.
8. Operate the vehicle following NJTRO operating rules.
9. When sleet scraping is finished, reconfigure the pantographs following NJTRO safety rules.

CAUTION: Do not reset the S7 Pantograph Selection switch or attempt any other shortcut to lower the isolated leading pantograph. Follow all the steps to reconfigure the pantographs for normal operation.

CHANGING OPERATING ENDS

To change operating cabs, you must cut out the currently operating cab, then inspect and set up the currently non-operating cab. See "Setting Up the Non-Operating Cab" and "Setting Up The Operating Cab" for procedures.

Reconfiguring the Pantographs

To reconfigure the pantographs when changing operating ends:

1. Move the Pantograph Selection Switch to the BOTH position and wait *10 seconds* for both pantographs to engage the catenary.
2. After 10 seconds, move the Pantograph Selection Switch to either F or B, depending on which is to be the trailing pantograph. The leading pantograph will lower immediately.
3. Operate the vehicle following NJTRO operating rules.

OPERATING THE HEP SYSTEM

1. Set the HEP on/off switch to OFF when coupling or uncoupling from cars or changing makeup of train.
2. The HEP isolation switch must be in the RUN TL for supplying head end power to the passenger cars.
3. During operation, observe that no AMBER or RED HEP lights are on at the Y3 cabinet.

NOTE: Although the condition is undesirable, the HEP system can operate with the HEP ONE FUSE BLOWN and/or the HEP GROUND light(s) on. Have this condition repaired as soon as possible. In addition, the TLC Right and Left Arrow light will remain on and is no indication of malfunction.

4. If HEP jumper cables are applied and looped at both ends of the locomotive, observe that TLC LEFT SIDE and TLC RIGHT SIDE lights are on.
5. At the Y3 cabinet, place HEP switch to ON.
6. When the pantograph is up, check the HEP system for the following:
   - The frequency meter indicates 60 Hz nominal.
   - The voltmeter indicates 480 volts nominal on positions 1-2, 2-3, and 3-1 of the HEP voltmeter selector switch.

You can shut down the HEP system by placing the HEP ISOLATION switch to OFF. This opens the main circuit breaker momentarily, shuts down the HEP system, and allows the auxiliary power system to operate at 220 V, 30 Hz, conditions allowing.

When HEP is not required because of a long wait before coupling to cars, place HEP ON/OFF switch to OFF.

The HEP system of one locomotive cannot be paralleled with another locomotive or with "wayside" power supplying the train.

If HEP is already energized from another supply, the HEP trainline feed external light is on and the HEP output contactor of the locomotive cannot be closed. You must remove this external feed to the train before the locomotive can furnish HEP to the train.

AUXILIARY POWER CONVERTER OPERATION

Normal operation of the Auxiliary Power Converter includes:

- Auxiliary power source selector is on the APL control panel.
- When propulsion or HEP is on, the auxiliary power system operates at three phase, 440 V, 60 Hz.
- When the main reservoir air pressure is above 135 psi and propulsion and HEP are off, the auxiliary power system operates at three phase, 220 V, 30 Hz. After the propulsion is turned off, there is a 15 minute delay before the system switches to three phase, 220 V, 30 Hz operation.

HEP CONVERTER OPERATION

Normal operation of the HEP Converter includes the following conditions:

- All four jumper cables must be installed to provide power to the cars.
- Lights on the HEP control panel are provided to indicate when all jumpers are in place and power is being applied to the cars.
- If the auxiliary power converter malfunctions, the HEP converter can supply the locomotive with auxiliary three-phase power.

BEFORE MOVING THE LOCOMOTIVE

1. View the duplex air gauges in the cab to be sure that main reservoir air pressure is between 130 and 140 psi.
2. Verify that the brakes are applied on the locomotive by observing the applied indicators on both trucks. (Red window is displayed.)
3. Use independent brake to check for proper release and application of locomotive brakes (75 psi brake cylinder pressure). Observe the brake applied indicators to verify that brakes are properly applied and released.
4. Check each side of the locomotive for chocks, chains, or other obstructions, removing them as necessary.
5. Once all obstructions have been removed, release handbrake.
6. Set reverser to F, N, or R.
7. Press and hold the indicating light test pushbutton on the indicating light panel. While pressing the pushbutton, check that all fault and indicating lights on both the desk and fault and indicating light panel come on.

PREPARING FOR DOUBLE HEADING

1. Observe NJTRO operating procedures and precautions before moving locomotive.
2. Couple the units together.
3. Stretch the coupling to ensure that couplers are locked.
4. Lower pantographs on both units by placing the Pantograph Down switch in both units to down.
5. Make sure:
   a. HEP is off.
   b. Throttles are in zero position.
   c. Reverser is in isolate (I) position.
   d. Brakes are applied.
6. Connect the brake pipe and main reservoir ("CAR SUPPLY") air hoses. Also connect the main reservoir, actuating, and independent application and release hoses between units, then slowly open angle cocks and cut-out cocks.
7. Connect 27-pin control, communication, and four HEP jumper cables between units. Be sure the short loop jumper cables (HEP supply) on the leading end are looped.
8. Make ground, roof, equipment room, and non-operating cab inspections on the added unit.
9. Raise desired pantograph on each unit.
10. Prepare the lead unit for double heading the same way you prepare a single or controlling unit of a consist (see "Setting Up The Operating Cab").

11. On the trailing unit:

    a. Make a full service application with the automatic brake valve, and place in LAP position.

    b. Place automatic brake valve cut off valve in OUT position.

    c. Place automatic brake valve in HANDLE OFF position.

    d. Place independent brake valve in RELEASE.

    e. Place the MU-2-A valve in TRAIL 24-26.

    f. Make sure that the brakes are controlled by the lead unit.

    g. Make sure that the throttle operation is normal.

12. On each locomotive:

    a. Set the multiple unit (MU) switch to the up position at each end where the two units are coupled.

    b. Set the MU switch to the down position at the non-coupled end of each locomotive.

COUPLING LOCOMOTIVE TO TRAIN

Caution: Always set the HEP ON/OFF switch to OFF before coupling or uncoupling from cars or changing makeup of train.

1. Couple to cars.
2. Stretch couplings to ensure couplers are locked.
3. Move independent brake valve to the fully applied position.
4. Couple main reservoir and brake pipe hoses to cars.
5. Open the main reservoir cut out cock slowly, then open the brake pipe angle cock slowly.
6. Install communication jumper cables and four HEP jumper cables.
7. If the HEP isolation switch is in RUN TL, check that the trainline complete left side and right side indicating lights go on.
8. If the HEP isolation switch is not in RUN TL, press the trainline complete test switch to obtain the trainline complete indications.

Observing Rules

Observe railroad operating rules, special instructions, air brake rules, and safety instructions concerning the following systems:

- Automatic Air Brakes
- Fire Extinguishers
- Cab Signal/Automatic Train Control

OPERATING THE LOCOMOTIVE

This section contains procedures for operating the ALP-44 locomotive.

STARTING AND ACCELERATING

1. Set reverser handle to F or R, as required.
2. Turn on the headlight, strobe light, and bell, as required.
3. Increase throttle power as necessary.

RESPONDING TO THE DYNAMIC BRAKE REDUCTION LIGHT

The DYNAMIC BRAKE REDUCTION light on the fault and indicating light panel may come on during long or frequent brake applications. This indicates that the braking resistors have reached their thermal capacity and dynamic braking current has been automatically reduced to a safe level. The blended brake control system automatically increases air braking to compensate for the decrease in dynamic braking.

The air brakes have the required capacity for total locomotive braking. Therefore, the reduction or loss of dynamic braking while in blended braking has no effect on locomotive braking effort or stopping distance.

RESPONDING TO THE NO POWER/BRAKE LIGHT

There is no propulsion power during a NO POWER/BRAKE condition. To resume power operation:

1. Return throttle to 0.
2. If desired, advance the throttle.

The NO POWER/BRAKE indicating light comes on when both:

- Independent or automatic brakes are applied to 20 psi B.C. or more.
- Throttle is in any position from P1 through F.

When it comes on, propulsion power is cut off automatically. If you release the brakes but leave the throttle in power positions P1 through F, the NO POWER/BRAKE indicator remains on and power remains off.

The indicator goes off when you return the throttle to 0. You may continue operation by advancing the throttle.

If it comes on when operating below 5 mph, propulsion power may be restored by either returning the throttle to the 0 position or by releasing the air brakes.

If it comes on a second time, while operating under 5 mph, the throttle must be returned to the 0 position to regain propulsion power. If the throttle was returned to the 0 position after the first occurrence, then propulsion power may be restored by either returning the throttle to the 0 position or by releasing the air brakes.

The NO POWER/BRAKE light also comes on if the locomotive exceeds 5 mph. In this case, the throttle must be returned to the 0 position, and the air brakes released before propulsion power is restored.

A penalty brake application is caused by any of the following:

1. Failure to reset the alerter when locomotive brakes are released.
2. Failure to acknowledge a more restrictive cab signal aspect.
3. Failure to initiate a temporary suppression within 4 to 6 seconds and a permanent suppression within an additional 4 to 6 seconds if:

   a. Locomotive is exceeding cab signal aspect speed.

   b. Locomotive speed exceeds 79 mph when the TERRITORY switch on the ADU panel is in the NON-CODED position.

NOTE: Observe NJT operating instructions concerning this system.

HANDLING PHASE BREAKS

The VC/PB system automatically reconfigures the locomotive as it enters sections with different catenary voltage and frequency.

If the VC/PB Auto switch in the S7 panel is off, then perform the changeover as follows:

1. Press and hold the Power Source Change Over pushbutton upon approaching a new catenary section (this opens the main circuit breaker).
2. Upon entering the new section, turn the power selector rotary switch to the appropriate voltage/frequency and release the Power Source Change Over pushbutton.

The main circuit breaker will not close if you have selected the wrong voltage or frequency.

REDUCING TRACTION MOTOR POWER

The ALP-44 reduces power to the traction motors automatically to prevent traction motor damage when operated above the continuous current rating for too long a period. The TRACTION POWER REDUCTION indicating light on the Fault and Indicating Panel comes ON when traction motor power is being reduced automatically.

When the motors have cooled and traction motor temperatures return to normal, the system returns to normal and the TRACTION POWER REDUCTION indication light goes out.

Excessive operation above the continuous current rating of the traction motors may be caused by any of the following:

- One or more traction motors cut out.
- Abnormal number of slow downs or stops.
- Abnormal train weight.

In addition, if a fault develops in any motor, traction motor blower, or speed pickup, the engineer can cut out or isolate the affected motor by either:

- Placing the propulsion isolator switch to ISOLATED position

or

- Reducing the throttle to zero, then setting the applicable traction motor cut out switch to OFF position.

RESPONDING TO THE PNEUMATIC CONTROL SWITCH LIGHT

The pneumatic control switch (PCS) resets the system following a penalty or emergency brake application.

Resetting After a Penalty Brake Application

1. Place the throttle in 0 position.
2. Place the automatic brake valve in LAP position.
3. After the PCS light goes out, release the brakes.

To prevent another penalty brake application:

1. Reset the alerter when the locomotive brakes are released.
2. Be sure to acknowledge a more restrictive cab signal aspect.
3. Temporarily suppress air brakes within 4 to 6 seconds and permanently suppress the air brakes within an additional 4 to 6 seconds if:
   - Locomotive is exceeding cab signal aspect speed.
   - Locomotive speed exceeds 79 mph when the TERRITORY switch on the ADU panel is in the NON-CODED position.

Resetting After an Emergency Brake Application

1. Place the throttle in 0 position.
2. Place the automatic brake valve handle in EMERGENCY position.
3. Allow at least 30 seconds for the A-1 charging valve cut-off pilot to reset.
4. Move the automatic brake valve to release position.
5. Make sure the PCS light goes out.

RESPONDING TO THE WHEEL SLIP LIGHT

If the amber WHEEL SLIP light stays on for five seconds and the speed pickup fault light comes on, do not operate the locomotive. Do the following:

1. Stop the locomotive
2. Thoroughly inspect the underbody and trucks for locked wheels or any other condition preventing the wheel from spinning.
3. Press flashing FAULT RESET button to restore power.
4. Place throttle in the 0 position and turn the appropriate circuit breaker off to cut out the affected motor.

NOTE: You do not have to respond to intermittent flashing of the WHEEL SLIP light. The wheel slip control system is correcting the slips. It is not necessary to reduce throttle position unless severe lurching occurs. Also, minor slipping or wheel creep does not activate the WHEEL SLIP light, but automatic sanding may occur along with regulation of power. This is not a power loss due to a fault.

WARNING: If the WHEEL SLIP light stays on for five seconds and the speed pickup fault light comes on, do not operate the locomotive. The wheels may be locked. Inspect as required.

TRANSFERRING HEP CONVERTER POWER TO AUXILIARY EQUIPMENT

1. Set the HEP ON/OFF switch (Y3 HEP control panel) to OFF.
2. Set the auxiliary power source selector on the S7 locomotive control panel (S7 electrical cabinet) to HEP.

3. Reset the faults by pressing the flashing FAULT RESET pushbutton (cab overhead panel).
4. If the auxiliary machines were transferred to the HEP converter after the second fault occurrence:

   a. Press the flashing FAULT RESET.

   b. Press the propulsion reset pushbutton.

   c. Press the FAULT RESET pushbutton a second time.
5. Observe the fault and indicating light panel:

   a. AUXILIARY POWER OFF and MAIN CRC. BRKR. OPEN lights go off.

   b. AUXILIARY FED FROM HEP light comes on.

   c. Ammeter on the Y3 HEP control panel reads 50 to 175 amperes.
6. To provide HEP to the cars, set HEP ON/OFF switch to ON.
7. Observe that the HEP OUT BRKR. CLOSED light goes on at both the Y3 HEP control panel and the Fault and Indicator panel.

NOTES: The HEP converter supplies the following amperage continuously:

- 750 amperes for train cooling
- 600 amperes for train heating

The HEP converter supplies the following amperage for a maximum of 30 minutes during any consecutive 60 minutes:

- 825 amperes for train cooling
- 660 amperes for train heating

If necessary, reduce HEP load of the cars to meet these values.

RESETTING THE BATTERY PROTECTOR

The battery protector circuit disconnects the battery from the DC control circuits when battery terminal voltage falls below 55 VDC and the battery charger is inoperative. This turns on the BATTERY PROTECTOR TRIPPED lights on the fault and indicating light panel and on the S7 locomotive control panel.

If the reverser handle is set to F, N, or R position with the battery switch closed, the ATC/CAB signal, radio, train communication circuits, strobe lights remain energized.

Generally, check the following whenever the BATTERY PROTECTOR TRIPPED light comes on:

a. Battery

b. Battery charger circuit breaker

c. Battery charger

In addition, press the battery protector trip press-to-test pushbutton indicator to test the condition of the lamp.

Specifically, perform the following to reset the battery protector:

1. Check for open battery charger circuit breaker.
2. Set battery protector override switch on S7 electrical cabinet to ON.
3. Raise pantograph to energize battery charger.
4. Check the battery charging ammeter to determine when the battery charger is supplying 74 volts DC to the locomotive control system.
5. When the control system is receiving 74 volts, press the battery protector reset pushbutton on the S7 electrical cabinet.
6. Return battery protector override switch to OFF.

7. If battery protector trips again, determine why batteries are not charging.
8. Once the batteries are charged, you can operate the locomotive.

STARTING AND ACCELERATING THE LOCOMOTIVE

The general procedure for starting and accelerating the locomotive is as follows:

1. Set reverser handle to F or R position as required.
2. Turn on headlight, strobe light, and bell as required.
3. Release both independent and automatic air brakes.
4. Observe that the Train Brake Applied light is off and the Train Brakes Released light is on.
5. Observe that the Door Closed light is on.
6. Slowly move the throttle handle back from the zero position until the desired locomotive speed is attained.

STARTING TRAIN ON ASCENDING GRADES

1. Make a full application using the independent brake valve, then ensure that the automatic brake valve is set to RELEASE position.
2. After the automatic brake has fully released, advance the throttle while gradually releasing the independent brakes.

CAUTION: Propulsion power is removed as indicated by a zero ammeter reading. In addition, the NO POWER/BRAKE light on the engineer's light panel comes on if the independent brakes are not fully released within 6 seconds after advancing the throttle, or if speed exceeds 5 mph. If the NO POWER/BRAKE light is on, power to the traction motors is cut off

3. If the NO POWER/BRAKE light comes on, restore propulsion power quickly by either returning the throttle to 0 or by fully releasing the air brakes, whichever ensures proper train handling.
4. If the NO POWER/BRAKE light comes on a second time, return the throttle to the 0 position to restore propulsion power.

Safety Considerations

To prevent rollback when starting on a steep grade, you may need to apply power while the independent brakes are set.

The power brake override system permits the application of power for 6 seconds with train speed below 5 mph and the independent brakes set.

When you must stop the locomotive on a steep ascending grade, you may apply sand during the last 50 feet to maximize adhesion for starting.

HANDLING A DEAD LOCOMOTIVE IN TRAIN

1. Drain all air from main reservoirs and air brake systems.
2. Place both MU-2-A valves in LEAD-DEAD.
3. Place automatic brake valve cut out valve to OUT.
4. Place independent brake valve handle to RELEASE.
5. Place automatic brake valve handle in HANDLE OFF position.
6. Open dead engine feature cut out cock.
7. Cut out ATC cut out cock on air brake rack.
8. Cut out safety control cut out cock on air brake rack.
9. Set the APL switch on the Y3 cabinet to DEAD.
10. Be sure pantographs are locked down and that grounding switches are closed.
11. Open battery switch.
12. As per NJTRO, be sure that the 26F release cap is in DIR position.

USING THE FAULT AND INDICATING LIGHT PANEL

The general response procedure to the Fault and Indicator lights are described below. The cause, effect, and remedial action for each indication on the panel is provided in Section 4.

Multiple Fault Reset Indications

To reset the circuit:

1. Return the throttle to 0.
2. Momentarily press the flashing FAULT RESET on the overhead switch panel, to cause the following:
   - Flashing light in the FAULT RESET pushbutton goes out.
   - Alarm bell is silenced.
   - Fault detecting relay resets and multiple fault reset light goes out.
   - Main circuit breaker closes or HEP to the cars is restored.
   - Normal operation allowed.
3. You can reset these fault circuits any number of times from the cab.

Single Fault Reset Indications

When a single fault reset light comes on, the locomotive has a serious fault, requiring immediate attention. To reset:

1. On the first occurrence, press the FAULT RESET.
2. On the second occurrence, set the throttle to 0 and push the FAULT RESET pushbutton to silence the alarm bell (does not reset relay).

3. To reset the relay on the second occurrence, press either the propulsion or HEP reset pushbutton.

NOTE: One propulsion reset pushbutton is located on the top left of the cab rear wall; another is on the S7 electrical cabinet in the equipment room.

One HEP reset pushbutton is located on the top left of the cab rear wall; another on the Y3 HEP control panel in the equipment room.

Although the propulsion and head end power fault reset pushbuttons on the cab rear wall duplicate the reset functions in the equipment room (S7, Y3), inspect the equipment room for the cause of the fault.

4. After resetting the fault detecting relay, reset the flashing FAULT RESET pushbutton in the cab a second time.

Both the propulsion and head end power reset pushbuttons start a new sequence so that the next reset can be made with the FAULT RESET pushbutton on the overhead switch panel.

The reset functions cause the following:

1. The fault detecting relay resets and the single fault reset light goes out.
2. If there is an auxiliary convertor fault, then auxiliary equipment can be transferred to the HEP convertor.
3. Resume operation by pressing the flashing FAULT RESET pushbutton.

Fault Indications Requiring Equipment Room Reset

All of the indicators in this group, except AIR COMPRESSOR STOPPED, cause the main circuit breaker to open or the auxiliary, HEP, and propulsion systems to shut down.

Setting the throttle to 0 position and momentarily pressing the flashing FAULT RESET pushbutton on the overhead switch panel assembly silences the alarm bell, but does not reset the relay.

To reset the fault detecting relay:

1. Press the appropriate pushbutton; either propulsion or HEP fault reset. (See SINGLE FAULT RESET INDICATION GROUP for pushbutton locations.)
2. Press the flashing FAULT RESET pushbutton in the cab a second time.

Both the propulsion and head end power reset pushbuttons start a new sequence so that the next reset can be made with the FAULT RESET pushbutton on the overhead switch panel. The propulsion and head end power fault reset functions cause:

1. The fault detecting relay to reset.
2. The light on the fault panel in the cab to go out.
3. Normal operation to be resumed after pressing FAULT RESET pushbutton, a second time.

Automatic Fault Reset Fault Indications

When the fault clears, the fault detecting circuits in this group reset automatically. The flashing light in the FAULT RESET pushbutton goes out after all of the following conditions are met:

- The fault indicating light has gone out
- The engineer has set the throttle to 0 position
- The engineer has pressed the FAULT RESET pushbutton on the overhead switch panel assembly

Unusual Condition Continued Operations

You cannot reset these faults. However, locomotive operation may continue, with some instances causing automatic power reductions.

An engineer can, momentarily, press the FAULT RESET pushbutton on the overhead switch panel assembly to turn off the flashing light in the FAULT RESET pushbutton. The light on the Fault and Indicator panel goes out when the fault clears. Continue operation, but report the defect to maintenance personnel.

NOTE: The DYNAMIC BRAKE REDUCTION and TRACTION POWER REDUCTION lights indicate that power is being reduced to permit continued operation at lower output. Report the defect to maintenance personnel.

Condition Group

These indications are mainly of informative nature, but some indicate faults that cannot be reset on the road.

Certain fault conditions open the main circuit breaker to disconnect all power from the high voltage circuits. This causes the MAIN CIRCUIT BREAKER OPEN light on the Fault and Indicator light panel to come on.

When the main circuit breaker opens the NO BATTERY CHARGE and AUXILIARY POWER OFF indicators come on. If the HEP isolation switch is in the RUN TL position when the main circuit breaker opens, the HEP POWER OFF light comes on.

The NO BATTERY CHARGE, AUXILIARY POWER OFF, and HEP POWER OFF lights do not necessarily indicate a fault in these systems. These come on when input power from the catenary is disconnected.

WARNING: Pantographs must be down and traction circuits de-energized before changing and testing fuse in accordance with the tables in Section 4. Only maintenance personnel should do this.

OPERATING THE RADIO

To use the radio as a public address system for passenger announcements:

1. Press and hold the rocker switch to the PA position.
2. Then press the PTT button on the radio or handset while talking.
3. To hear person on the other end, release the PTT button.

To use the radio as an intercom for talking to train personnel:

1. Press and hold the rocker switch to the INT position.
2. Then press the PTT button on the radio or handset while talking.
3. To hear person on the other end, release the PTT button.

NOTE: Both the radio and handset can be used for PA and INT. However, use the handset in PA mode to minimize noise.

To use the radio for frequency transmission:

1. Leave rocker switch in the normal RADIO position.
2. Press appropriate PTT button.

NOTE: When on, the radio monitors and receives wayside radio frequency transmissions continuously, even while PA or INT modes are in use.

OPERATING THE HANDBRAKE

To set the handbrake:

1. Using a pumping action, pull the hand lever upward until it no longer moves.
2. Observe that the chain moves slowly through the housing as the chain weight drops.
3. After the chain weight has dropped, return the lever to the vertical position.
4. Observe that the appropriate handbrake applied lights in the cab and on the locomotive exterior have turned on.

To release the handbrake:

1. Check that the hand lever is secure in the retainer.
2. Pull the trip lever upward sharply.
3. Observe that the chain moves rapidly through the housing until the snubber on the chain weight contacts the bottom of the housing. Snubber is fully released when it is within one inch of the housing.
4. If the handbrake does not release completely, reset it to the maximum force and release it again.
5. Make sure the cab and exterior handbrake applied indicators have turned off.

OPERATING MISCELLANEOUS EQUIPMENT

The cab seat can be adjusted for back support as well as for distance from the desk. Use the knob to the lower right or left of the seat to adjust the seat back. Use the lever under the seat to adjust for legroom and easy access to the desk.

Raise and lower the sash windows in the cab by finger-squeezing the control lever at the top of each window.

The toilet, located behind the compressor and across from the S7 cabinet, operates with a pump handle to produce flushing.

OPERATING THE LOCOMOTIVE, UNUSUAL CONDITIONS

This section contains procedures for unusual operating conditions caused by inclement weather, adverse terrain, or system faults.

Running Through Water

Do not run the locomotive through water that is deeper than 3 inches above the rail or touches any traction motor.

Never exceed 2 mph when operating with water over the rails.

Operating Over Rail Crossing

Within eight seconds on approaching rail crossings at grade, reduce throttle position as follows:

- Above 25 mph: To No. 5 position.
- Below 25 mph: To next lower position, not exceeding No. 4 position.

Permit all locomotives in train to clear crossing before advancing the throttle.

NOTE: This procedure is necessary to ensure decay of motor and converter voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the traction motor brushes.

LEAVING LOCOMOTIVE SECURED AND DE-ENERGIZED

1. Set handbrake.
2. Set automatic brake to full service, then place in LAP position.
3. Move independent brake valve to the fully applied position.
4. Move reverser handle to Isolate, then remove and store the reverser handle.
5. Place the automatic brake valve to OUT.
6. Place the automatic brake valve handle to Handle Off (HO).
7. Place the MU-2A Valve to TRAIL 24-26.
8. Set Pantograph Down switch to the down position.
9. Set all lights and heater switches to OFF.
10. Open battery switch.
11. As a safety precaution, chock both sides of at least one wheel.

SECTION 4:
RESPONDING TO THE FAULT AND INDICATOR LIGHTS

INDICATING PANELS

Table 4-1 lists the faults and conditions displayed on the fault and indicator light panel in the operating cab. HEP faults are displayed on the HEP control panel as well as on the operating cab indicator light panel. An asterisk (*) indicates which faults are indicated on both panels.

Table 4-2 lists the indicating lights on the HEP control panel. These HEP indicators provide information related to HEP faults and operating conditions.

BASIC FAULT RESETTING PROCEDURES

The fault circuits are classified as multiple fault reset, single fault reset, automatic fault reset and machine room reset. Generally, these refer to the following fault modes:

- Manual resetting, continue operation
- Isolate faulted system, then continue operation
- Automatic resetting, continue operation
- Stop and stay, shut down, then get help before continuing operation

Resetting Multiple Faults

To reset multiple fault reset circuits:

1. Return the throttle to 0 position.
2. Press the flashing FAULT RESET pushbutton on the overhead switch panel.
3. Repeat steps 1 and 2, as necessary.

Resetting Single Faults

To reset the single fault reset circuits after the first occurrence:

1. Return the throttle to 0 position.
2. Press the flashing FAULT RESET pushbutton.

If the same fault occurs again:

1. Return the throttle to 0.
2. Press the PROPULSION RESET or HEP FAULT RESET pushbutton on the top left side of the cab rear wall.
3. Have the machine room inspected for the cause of the fault.

NOTE: These same reset functions are duplicated in the machine room on the S7 electrical cabinet or the Y3 HEP cabinet.

Responding to Automatic Fault Resets

The automatic fault reset indications automatically reset if the fault condition clears. In addition, certain faults do not require that the throttle be returned to 0 to reset. You can reset the next occurrence of the same fault by returning the throttle to 0 position and pressing the FAULT RESET pushbutton on the overhead switch panel. In this way, continued fault reset may be performed by returning the throttle to 0 and alternating between the FAULT RESET pushbutton on the overhead switch panel and the PROPULSION RESET or HEP FAULT RESET pushbuttons on the cab rear wall.

If fault reset procedures are performed out of sequence, pressing the FAULT RESET pushbutton silences the alarm bell, but the flashing FAULT RESET pushbutton continues to flash and the fault indicating light remains on until the PROPULSION RESET or HEP FAULT RESET pushbutton is pressed. You can then resume locomotive operation by returning the throttle to 0 and pressing the flashing FAULT RESET pushbutton.

NOTE: Although it is possible to reset fault detection circuits more than one time, follow applicable railroad instructions when resetting the fault detection circuits. In addition, the locomotive engineer must report faults to the proper maintenance personnel using the appropriate railroad reporting form. Also, when faults resulting in emergency stops occur, follow NJTRO and NJTDOT safety and emergency procedures.

Table 4-1. Faults and Conditions

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AIR COMPRESSOR HOT OIL	Air compressor lube oil temperature between 220°F and 250°F. No effect on operation.	None. Light goes out automatically when oil temperature decreases below 215°F.
CAUTION Additional propulsion reset and head end power fault reset buttons are located at the top left side of the cab rear wall. Although these buttons duplicate the reset functions in the equipment room (S7, Y3), you should inspect the equipment room for the cause of the fault.		
AIR COMPRESSOR STOPPED	Air compressor lube oil temperature above 250°F, or air compressor motor thermal overload tripped. Main reservoir air supply depletes due to brake applications and/or brake pipe leakage. If main reservoir pressure drops below 75 psi, the main circuit breaker opens.	1. Press the flashing FAULT RESET button on the overload sliding switch panel assembly to cancel the flashing light. 2. Once the compressor lube oil has cooled or the drive motor thermal overload has automatically reset, start the compressor by placing the throttle in O, then pressing the propulsion reset button.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUTOMATIC POWER REDUCTION	Thyristor fuses blown, thyristor coolant temp. above 145°F, transformer coolant 203°F to 221°F, traction motor thermal capacity reached or pressductor system failed. TM current is limited during power as follows: a. 1250 amps when transformer coolant is between 203°F and 221° F. b. 1125 amps when thyristor fuses are blown. c. The continuous rating when the thermal capacity has been attained. d. 1250 amps when the pressductor system is inoperative. e. Current starts limiting when thyristor coolant rises above 140°F; limited to 1100 amps at 194°F.	1. Press flashing FAULT RESET button to cancel flashing light. 2. If fuses are blown, replace fuses and press propulsion reset button to restore normal operation. 3. Normal operation of 2250 amps maximum traction motor current limit is restored when coolant or traction motor temperature decreases to normal. NOTE: If the battery switch is opened on a trailing unit, the Automatic Power Reduction light comes on in all units coupled in the consist. This does not affect the operating units' power.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUTO VC/PB FAULT	Automatic voltage changeover/phase break system fault.	1. Observe that the MAIN CIRCUIT BREAKER OPEN light on the Fault and Indicator light panel has come on. 2. Follow NJT Operating Rules for returning power to the locomotive.
AUXILIARY FUSES BLOWN	Auxiliary converter fuses blown. Auxiliary, HEP, and propulsion systems shut down.	1. Press flashing FAULT RESET button to silence alarm bell. 2. Replace auxiliary converter fuses or transfer auxiliary equipment to HEP converter, then press the propulsion reset button to reset fault detection relay. 3. Press flashing FAULT RESET again to cancel flashing light and restore operation.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUXILIARY GROUND	Auxiliary power system is grounded. No effect on operation.	1. Press flashing FAULT RESET to cancel flashing light. Make repairs as soon as possible. 2. After repairing the ground, press the propulsion reset button to cancel the fault and indicating light.
AUXILIARY ONE FUSE BLOWN	Indicates single fuse in auxiliary converter capacitor unit is blown. No effect on operation.	1. Press flashing FAULT RESET button. 2. Replace the fuse and press the propulsion reset switch to turn off the fault indicator.
AUXILIARY POWER OFF	Comes on when auxiliary equipment does not receive APL output power.	Restore auxiliary power or transfer auxiliary equipment to HEP converter.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUXILIARY SECONDARY OVERLOAD	Indicates secondary winding of main transformer to auxiliary power converter has been overloaded. Main circuit breaker opens.	1. Press flashing FAULT RESET to silence the alarm bell. 2. Press propulsion reset button to reset the fault detection relay. 3. Press FAULT RESET a second time to restore operation. 4. If fault repeats, transfer auxiliary equipment to HEP system.
BATTERY PROTECTOR OVERRIDE	Indicates that battery protector override switch is ON. Pantograph may be raised to energize the battery charger.	1. Press battery protector reset. 2. When battery charger is providing 74 volts to the control system, return battery protector override switch to OFF.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
AUXILIARY CONVERTER FAULT	Any fault in the auxiliary power converter system. Auxiliary, HEP, and propulsion systems shut down.	1. Press FAULT RESET to cancel flashing light. 2. Reset auxiliary power system fault if first time. 3. If fault repeats, press flashing FAULT RESET button to silence alarm. 4. Transfer auxiliary equipment to HEP system. 5. Press propulsion reset button to reset fault relay. 6. Press FAULT RESET again to restore operation. 7. If HEP overloads, reduce HEP to cars, then press the HEP FAULT RESET button to restore operation.
AUXILIARY FED FROM HEP	HEP system is providing power to the auxiliary equipment.	If HEP is not overloaded, no action required. Normal operation may continue, but HEP to cars may need to be reduced.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
BATTERY PROTECTOR TRIPPED	Batteries have discharged below 55 volts and have been disconnected from the locomotive control system. Main circuit breaker opens and pantographs lower. Also, all control and lighting circuits lose energy. If reverser is in F, N, or R and the battery switch is closed, the radio, ATC/CAB signal, train communication circuits, and strobe light circuits remain energized.	1. Check for open battery charger circuit breaker. 2. Set battery protector override switch on S7 electrical cabinet to ON. 3. Raise pantograph to energize battery charger. 4. When the battery charger starts supplying 74 volts DC to the locomotive control system (battery charging ammeter), press the battery protector reset button on the S7 electrical cabinet. 5. Return battery protector override switch to OFF. 6. If battery protector trips again, determine the reason for failing to charge.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
BLENDED BRAKE LOCKOUT	Dynamic braking is cut out. Air braking increases to compensate. No loss in total braking effort; wear and tear on tread and disc brakes increase.	Check blended brake system as soon as practical.
BLOWER STOPPED	Compressor radiator blower, converter blower, equipment room blower, or traction motor blower stopped because circuit breaker is in off position or an overload trip occurred. If all three converter blowers stop, the auxiliary power, HEP, and propulsion systems shut down. If any other blower stops, operation continues until critical temperature is reached.	1. Press flashing FAULT RESET to cancel flashing light. 2. Reset the applicable circuit breaker to restore blower operation. 3. If a traction motor blower cannot restart, cut out the motor to continue locomotive operation.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
CABINET HIGH TEMPERATURE	Temperature is excessive in the S7 electrical cabinet, Y1 thyristor converter cabinet, Y2 electronic cabinet, or Y3 HEP filter.	1. Press flashing FAULT RESET to cancel flashing light. 2. After the cabinet temperature has decreased, return the throttle to O to start the propulsion and APL systems. 3. After the fault indication goes out, advance the throttle as necessary. 4. Check that HEP operation resumes automatically when temperature is at a safe level.
DYNAMIC BRAKE OVERLOAD	Dynamic braking current has exceeded 1300 amps. Propulsion, ALP, or HEP shuts down.	1. Press flashing FAULT RESET to cancel flashing light, silence alarm bell, and close the main circuit breaker. 2. If fault repeats, cut out dynamic breaking.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
DYNAMIC BRAKE REDUCTION	Thermal capacity of the dynamic braking resistors has been reached and braking current has been gradually reduced to 450 amps to prevent resistor damage.	1. If operating in blended brake, take no action. Air braking increases to compensate and there is no change in overall braking effort. Dynamic braking will return to normal when brake resistor temperature is reduced to normal. 2. If operating in only dynamic braking, apply air brakes to compensate for the decrease in dynamic braking effort.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
*HEP CONVERTER FAULT	No HEP line power; main circuit breaker opens.	1. Press flashing FAULT RESET to cancel flashing light and reset HEP (first occurrence). 2. If fault occurs a second time, press flashing FAULT RESET to silence alarm, but not reset HEP. 3. Press the HEP reset button to reset fault relay. 4. Press the FAULT RESET again to close the main circuit breaker and resume operation. 5. If fault persists, open the HEP isolation switch.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
*HEP FUSES BLOWN	HEP converter fuses blown; main circuit breaker opens.	1. Press flashing FAULT RESET to silence alarm. 2. Place HEP isolation switch to OFF. 3. Press HEP fault reset button. 4. Press FAULT RESET again to restore locomotive operation. 5. Replace HEP converter fuses before operating the HEP system.
*HEP GROUND	HEP system or trainline is grounded. No effect on operation.	1. Press flashing FAULT RESET button to cancel flashing light. 2. Make repairs as soon as practical. 3. After repairing the ground, press the HEP reset button to cancel the fault indicating light.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
*HEP ONE FUSE BLOWN	Single fuse blown in HEP converter capacitor unit. No effect on operation.	1. Press flashing FAULT RESET to cancel flashing light. 2. Replace fuse and press HEP fault reset to cancel fault indicator light.
*HEP OUT BREAKER CLOSED	HEP system is providing power to the HEP trainline system; normal operation.	No action required.
*HEP OVERLOAD	HEP system overloaded; HEP trainline power off.	1. Press flashing FAULT RESET to silence alarm. 2. Press HEP fault reset button to restore HEP. 3. Press FAULT RESET again to restore operation. 4. If fault repeats, reduce the load on the HEP inverter (600 amp max for heating; 750 amp max for cooling).

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP POWER OFF	HEP isolation switch closed and no HEP power to trainline.	1. If accompanied by a fault indication, press FAULT RESET to cancel flashing light. 2. Check other indicating lights to determine reason for no HEP power.
*HEP SECONDARY OVERLOAD	Secondary winding of main transformer to HEP system has been overloaded. Main circuit breaker opens and HEP POWER OFF indicator comes on.	1. Press flashing FAULT RESET to silence alarm. 2. Press propulsion reset button to reset fault detection relay. 3. Press FAULT RESET button again to restore operation. 4. If the fault repeats, open HEP isolation switch.
MAIN CIRCUIT BREAKER OPEN	Normal indication if no other indicating lights are on.	If FAULT RESET is flashing, press it to cancel flashing light and silence the alarm bell.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
NO BATTERY CHARGE	Battery is not being charged. Normal operation may continue, but battery will discharge. Battery Protector will remove battery load if battery voltage decreases below 55 volts.	Check for open battery charger circuit breaker.
OIL PUMP OVERLOAD	Converter or transformer coolant pump motor thermal overload tripped. Auxiliary, HEP, and propulsion shut down.	1. Press flashing FAULT RESET to silence alarm. 2. Thermal overload resets automatically, restoring normal locomotive operation when temperature decreases below pickup value. 3. After thermal overload resets, return throttle to O and press flashing FAULT RESET to cancel flashing light.
PRESSDUCTOR FAULT	One or more pressductor faults. If in any traction motor, causes automatic reduction to 1250 amps in all motors.	1. You can continue abnormal operation to a repair point. 2. Correct the problem before resuming normal operation.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
SPEED PICKUP FAULT	One or more speed pickup faults. Propulsion system shuts down; traction motor fault lights indicate affected motors.	1. Press flashing FAULT RESET to cancel flashing light. 2. Place throttle in O. 3. Cut out affected motors. 4. Operate at reduced power with motor(s) cut out. 5. Go to nearest repair point.
THYRISTOR FUSES BLOWN	Fuses blown on one of the traction motor module converters. Thyristor fuses blown on traction motor module 1 or 2 automatically reduces power to the affected motor module.	1. Press flashing FAULT RESET to cancel flashing light. 2. Replace thyristor fuses. 3. Press propulsion reset buttons to resume operation.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRACTION MOTOR ARMATURE GROUND	Traction motor armature is grounded or traction motor flashover. If traction motor flashover occurs, the TRACTION MOTOR OVERLOAD may come on. The main circuit breaker opens.	1. Press flashing FAULT RESET to cancel flashing light, silence alarm bell, and close main circuit breaker. 2. If fault repeats, press FAULT RESET again. 3. If this occurs three times, the faulty module cuts out automatically. 4. If MAG121 has operated, cut out traction motor 1 or 2 and determine if operation can continue at reduced power. 5. If MAG341 has operated, cut out traction motor 3 or 4 and determine if operation can continue at reduced power.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRACTION MOTOR CURRENT EXCESSIVE	Traction motor current exceeding throttle or other reference levels.	Run at reduced throttle.
TRACTION MOTOR CUTOUT	One or more traction motors are cut out. Operation continues at reduced power.	No direct action required; refer to effect of associated indication.
TRACTION MOTOR 1, 2, 3, OR 4 FAULT	Identifies specific traction motor associated with fault displayed by other indications.	Refer to effect of associated indication.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRACTION MOTOR FIELD GROUND	Ground in traction motor field circuit. Main circuit breaker opens.	1. Press flashing FAULT RESET to cancel flashing light, silence alarm, and close main circuit breaker (first occurrence). 2. On second occurrence, press FAULT RESET again, then, with throttle in O, cut out traction motors one at a time. 3. Press FAULT RESET again to restore operation.
TRACTION MOTOR OVERLOAD	Current of at least one traction motor has exceeded 3600 amps or voltage has exceeded 1050 volts. Main circuit breaker opens; TRACTION MOTOR 1, 2, 3, or 4 Fault light indicates motor affected.	1. Press flashing FAULT RESET to cancel flashing light, silence alarm, and close main circuit breaker. 2. If fault repeats, cut out affected motor and operate at reduced power.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRACTION MOTOR SECONDARY OVERLOAD	Traction motor secondary winding of main transformer has overloaded. Main circuit breaker opens.	1. Press flashing FAULT RESET to silence alarm. 2. Press propulsion reset button to reset fault detection relay. 3. Press FAULT RESET again to restore operation.
TRACTION POWER REDUCTION	Traction motor thermal capacity has been reached. Locomotive power gradually reduces to continuous rating.	No action required.
TRAILING UNIT FAULT	Any fault condition in the trailing unit indicated in the lead unit.	1. Press flashing FAULT RESET to silence alarm. 2. If fault is not reset, check trailing unit for specific fault.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRANSFORMER /THYRISTOR HIGH TEMPERATURE	Transformer temperature above 203°F, or thyristor temperature above 145°F. Locomotive power automatically reduced (see AUTOMATIC POWER REDUCTION indication). Main circuit breaker opens if transformer temperature exceeds 221°F.	1. Press flashing FAULT RESET to cancel flashing light and silence alarm. 2. When the temperature is reduced, observe that locomotive power returns to normal. 3. If the main circuit opens, allow the main transformer oil temperature to cool before continuing locomotive operation. 4. When the fault indicating light goes out, return the throttle to O. 5. After the main circuit breaker closes and locomotive operation is restored, press the flashing FAULT RESET button to cancel the flashing light.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TRANSFORMER /THYRISTOR LOW OIL PRESSURE	Auxiliary, HEP, and propulsion systems shut down.	1. Press flashing FAULT RESET to silence alarm. 2. Check for low oil level. 3. After the cause has been determined and corrected, press propulsion reset button to reset fault detection relay. 4. Press the FAULT RESET button to restore operation.
TRANSFORMER PRIMARY OVERLOAD	Transformer primary current exceeds: 1800 amps at 11kV catenary voltage, 1000 amps at 12.5 kV, 60 Hz catenary voltage, or 500 amps at 25 kV, 60 Hz catenary voltage.	Press flashing FAULT RESET to silence alarm, cancel flashing light, and close the circuit breaker.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
VC/PB FAULT	Transformer and/or lightning arrestor connections are not correct for catenary power being sensed. Main circuit breaker opens.	1. If operating from the automatic VC/PB system, set automatic VC/PB cut out switch to OFF. 2. Set the Power Source Selector as applicable. 3. Move the APPROACH PHASE BREAK/PHASE BREAK OVER switch to APPROACH PHASE BREAK position. 4. Move the APPROACH PHASE BREAK/PHASE BREAK OVER switch to the PHASE BREAK OVER position to close the main circuit breaker and resume operation. 5. Observe that the VC/PB indicator goes out, the main circuit breaker closes, and that normal operation can be resumed.

Table 4-1. Faults and Conditions (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
15, 24 VDC FAULT	15 VDC and/or 24 VDC control fault. Main circuit breaker opens.	1. Press flashing FAULT RESET to silence alarm. 2. Be sure electronics circuit breaker is closed. 3. Press propulsion reset button to reset fault detection relay. 4. Press FAULT RESET again to restore operation.

Table 4-2. HEP Faults and Indications

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP AC TO CONVERTER ON	Single phase AC is applied to HEP converter. Normal HEP operation.	No action required.
HEP CONVERTER FAULT	HEP converter fault. HEP trainline power off; main circuit breaker opens.	1. Press flashing FAULT RESET button to cancel flashing light and reset HEP system (first occurrence). 2. If fault occurs a second time, press flashing FAULT RESET to silence alarm. 3. Press HEP fault reset button to reset the relay. 4. Press the FAULT RESET button again to close the main circuit and resume operation. 5. If the fault persists, open the HEP isolation switch.

Table 4-2. HEP Faults and Indications (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP FUSES BLOWN	HEP converter fuses blown. Main circuit breaker opens.	1. Press flashing FAULT RESET to silence alarm. 2. Place HEP isolation switch to OFF. 3. Press HEP fault reset button to reset the fault detection relay. 4. Press FAULT RESET again to restore locomotive power. 5. Replace HEP converter fuses before operating the HEP system.
HEP GROUND	HEP system or HEP trainline is grounded. Does not affect operation.	1. Press flashing FAULT RESET to cancel flashing light. 2. Make repairs as soon as practical. 3. After repairing the ground, press the HEP fault reset button to cancel the fault and indicating light.

Table 4-2. HEP Faults and Indications (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP ONE FUSE BLOWN	Single fuse blown in HEP converter capacitor unit. Does not affect operation.	1. Press flashing FAULT RESET to cancel flashing light. 2. Replace fuse. 3. Press HEP fault reset button. 4. Perform required maintenance as soon as practical.
HEP OUT BREAKER CLOSED	HEP output circuit breaker is closed for normal operation.	No action required.

Table 4-2. HEP Faults and Indications (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP OVERLOAD	HEP system overloaded. Trainline power removed.	1. Press flashing FAULT RESET to silence alarm. 2. Press HEP fault reset button to restore HEP. 3. Press FAULT RESET again to restore operation. 4. If fault repeats, reduce the load on the HEP inverter (600 amps max for heat; 750 amps max for cooling).
HEP SECONDARY OVERLOAD	Secondary winding of main transformer to HEP system has been overloaded. Main circuit breaker opens and HEP POWER OFF indicator comes on.	1. Press flashing FAULT RESET to silence alarm. 2. Press propulsion reset button to reset fault detection relay. 3. Press FAULT RESET button again to restore operation. 4. If the fault repeats, open HEP isolation switch.

Table 4-2. HEP Faults and Indications (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
HEP TR LINE FEED EXT	HEP trainline is fed from layover power source or another locomotive. HEP cannot be parallel with another source.	Remove other source to provide HEP.
HEP VOLT Hz FAULT	HEP voltage outside normal limits of 440 to 490 volts, or frequency is outside normal limits of 58 to 62 Hz for more than 5 seconds. HEP trainline power off. Also results in a HEP CONVERTER FAULT indication.	1. Press flashing FAULT RESET to cancel flashing light and reset HEP system (first occurrence). 2. If fault occurs a second time, press flashing FAULT RESET to silence alarm. 3. Press HEP fault reset button to reset the relay. 4. Press the FAULT RESET button again to close the main circuit and resume operation. 5. If the fault persists, open the HEP isolation switch.

Table 4-2. HEP Faults and Indications (cont'd)

INDICATION	CAUSE/*EFFECT*	REMEDIAL ACTION
TLC LEFT SIDE or TLC RIGHT SIDE	HEP trainline circuit is complete. HEP may be applied to train. If either or both lights go out, HEP trainline is not complete and HEP power cannot be fed to trainline.	1. If light is out, check all HEP trainline connections. 2. Replace HEP trainline jumpers, if necessary.

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APPENDIX A: GENERAL DATA

Locomotive:

Model Designation	ALP-44
Locomotive Type	Bo-Bo
Transformer (Silicone Oil Cooled)	Primary Voltages: 11 kV/25 Hz 12.5 kV/60 Hz 25 kV/60 Hz
Rectifier (Oil Cooled)	Thyristor Controlled
Continuous Rating (IEC 349)	4320 kW
Maximum Diesel-Equivalent Horsepower	7000

Traction Motors (4):

Model	ABB LJH 108-8
Type	DC, Separately Excited, Hollow Drive Shaft Motor
Maximum Short Time Tractive Effort	51,500 lbs
Current Rating Max. Continuous	1290 Amperes
Current Rating Max. During Acceleration	2250 Amperes

Driving Wheels (4 Pair):

Diameter	51.2 in.
Gear Ratio	85:36
Maximum Speed	125 mph

Power For Auxiliary Machines:

Rating	3 Phase, 440 V, 60 Hz,175 kVA at 0.8 p.f.
HEP for Cars	
Rating	3 Phase, 480 V, 60 Hz,625 kVA, 500 kW, 10% overload 1/2 hour each hour
Pantograph (2)	
Type	Brecknell-Willis HI-SPEED; Model 29500A Single Stage

Air Compressor, Gardner-Denver Rotary Screw:

Capacity	55 cu.ft./min. Low Speed (900 RPM) 135 cu.ft./min. High Speed (140psi/1800 RPM)

Storage Battery:

Type	Lead Acid
Number of Cells	32
Voltage	64 VDC
Rating (8 hour)	440 Amp Hour
Sand	Two 5.3 cu.ft. Boxes; one at each end
Air Brakes	26 LIC/CS2

Weight on Drivers:	
Maximum	207,000 lbs
Maximum Per Axle	51,670 lbs
On Drivers	100%
Height Over Locked Down Pantograph	14 ft. 8-1/2 in.
Width Over Handrails	10 ft. 5-9/16 in.
Major Dimensions:	
Length Over Pulling Faces	51 ft. 1-25/32 in. (72 ft. maximum)
Width Over Body	10 ft.
Truck Wheel Base	9 ft. 0-11/16 in.
Truck Centers	25 ft. 7-1/16 in.
Height Over Fully Extended Pantograph (Nominal)	25 ft. 6-1/2 in.
Curve Negotiation Two Units Coupled (Limited by Truck Swing)	23.4° or 245 ft. Radius

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APPENDIX B:
LIST OF ABBREVIATIONS

A	Ampere
AAR	American Association of Railroads
AC	Alternating Current
ADU	Aspect Display Unit
Amp	Amperes
APL	Auxiliary Power - Locomotive
ATC	Automatic Train Control
B.C.	Brake Cylinder
BPCOC	Branch Pipe Cut Out Cock
cont'd	Continued
CFM	Cubic Feet per Minute
cu.ft.	Cubic Feet
cu.in.	Cubic Inches
DC	Direct Current
F&I	Fault and Indicating Light Panel
ft.	Feet
HEP	Head End Power
Hz	Hertz
in.	Inch or Inches
kV	Kilovolt
kVA	Kilovolt Ampere
LA12	Lightning Arrestor 19.2 kV
LA25	Lightning Arrestor 36 kV
lbs	pounds
max	Maximum
MCB	Main Circuit Breaker
M&E	Morris and Essex
min	Minimum
min.	Minute
mph	Miles Per Hour
MU	Multiple Unit

NJT	New Jersey Transit
NJTRO	New Jersey Transit Railroad Operations
NJDOT	New Jersey Department of Transportation
no.	Number
nos.	Numbers
PCS	Pneumatic Control Switch
p.f.	Power Factor
psi	Pounds Per Square Inch
RPM	Revolutions per Minute
S7 Cabinet	S7 Electrical Cabinet
TR	Train
TL	Trainline
TM	Traction Motor
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current
VC/PB	Voltage Changeover /Phase Break
Y1 Cabinet	Y1 Thyristor Converter Cabinet
Y2 Cabinet	Y2 Electronic Cabinet
Y3 Cabinet	Y3 HEP Control Cabinet

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